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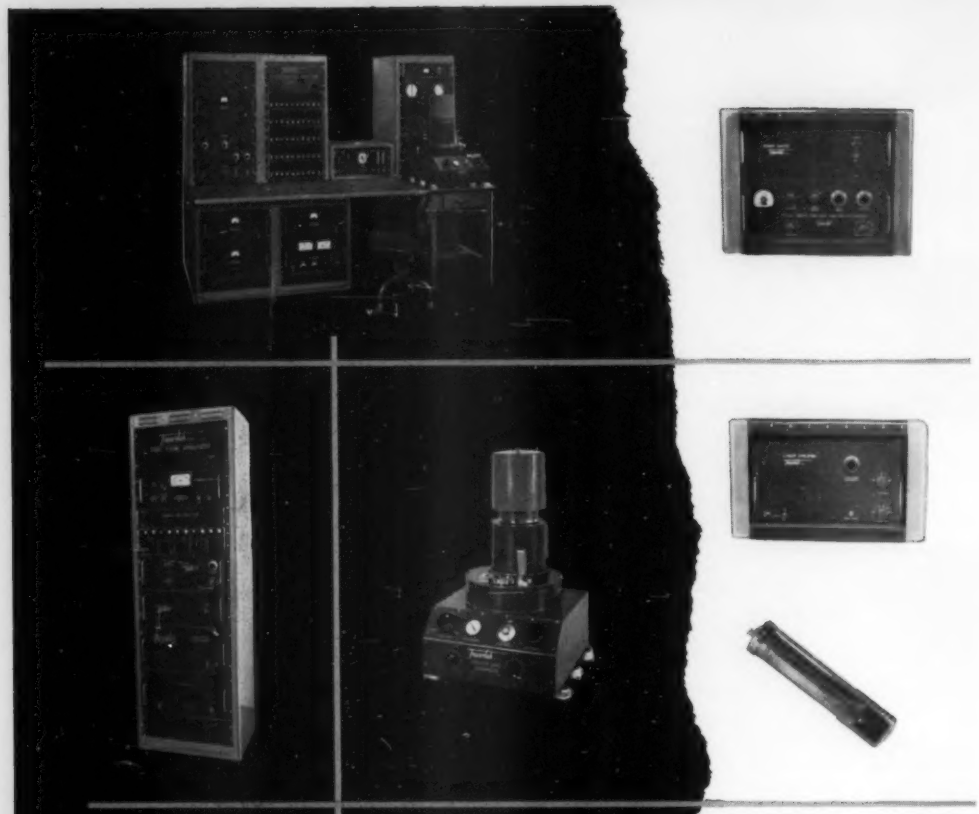

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Manpower Statistics

In writing or talking about manpower problems it is tempting to cite specific figures; they make one sound so much more authoritative. Yet the figures cited by one author do not always agree with those given by another, and an attempt to analyze the figures and to learn how they were developed frequently demonstrates that their foundations are very shaky indeed.

It is therefore a distinct service to all who are concerned with manpower matters to make carefully compiled statistical information generally available. The National Science Foundation has recently performed this service with the publication of *Scientific Personnel Resources*, a census-type handbook known to those who compiled it as "the fact book." It summarizes from many sources a wide variety of statistical information on the supply, utilization, and training of scientists and engineers in the United States. Many of the figures are estimates, and the error of estimate is frequently both unknown and unknowable. But the authors have collected their figures from a variety of sources, have checked and compared and analyzed with care and caution, and have produced a very useful reference source. *Scientific Personnel Resources* is now the place to look if one wants to know the percentage of physicists with Ph.D. degrees, the age distribution of mathematicians, the expected number of engineering graduates in 1960, the number of high I.Q. high-school graduates who do not go to college, or if one wants information on any of quite a large number of similar questions concerning scientists or engineers in general or those in a particular field. It is available from the Superintendent of Documents, Government Printing Office, and, for those interested in such figures, is the best half-dollar bargain on the current book market.

The Fund for the Advancement of Education has published a similar fact book about teachers (Bulletin No. 2, free). More limited in scope, it summarizes the available information on population and school attendance trends and on the current and prospective future supply of teachers for the schools of the United States.

The fact that many of the figures are estimates is not as great a handicap as a comparable lack of precision would be in some other fields. Any effort to deal with manpower problems gets one immediately into the area of public policy, and the outcome of one's efforts will be influenced by a variety of factors that cannot be predicted in an exact quantitative sense. In such a situation there is frequently but little difference between the value of reasonable estimates and more precise knowledge. As a matter of fact, many of the estimates can be shifted up or down to a considerable extent by changing one's definitions; to agree on the number of physicists in the country requires agreement on the definition of a physicist. Agreement on the number of physicists needed in 1965 would impose the further requirement that we agree on what we mean by *need*. No wonder estimates and forecasts of scientific manpower disagree.

This is not to say that statistical information is of no value. On the contrary, there are many ways in which it is useful to be able to compare 1955 with 1950, or 1940, or 1900, to compare physicists with chemists, to examine changing trends within a particular science, or to try to estimate a situation in 1965 if existing trends continue unaltered. In any such effort we can be grateful for the availability of carefully and comparably made estimates. The availability of such estimates, plus the realization of their limitations, should remove some of the confusion that has existed in discussions of scientific manpower problems. Future discussions can spend less time in trying to decide the facts of the case and more time in considering what can be done.—D. W.

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Farther Experiments and Observations in Electricity

Benjamin Franklin

§1. There will be the same explosion and shock if the electrified phial is held in one hand by the hook, and the coating touch'd with the other, as when held by the coating, and touch'd at the hook.

2. To take the charg'd phial safely by the hook, and not at the same time diminish its force, it must first be set down on an electric *per se*.

3. The phial will be electrified as strongly, if held by the hook, and the coating apply'd to the globe or tube; as when held by the coating, and the hook apply'd (*1*).

4. But the *direction* of the electrical fire being different in the charging, will also be different in the explosion. The bottle charged through the hook, will be discharged through the hook; the bottle charged through the coating, will be discharged through the coating, and not otherways; for the fire must come out the same way it went in.

5. To prove this, take two bottles that were equally charged through the hooks, one in each hand: bring their hooks near each other, and no spark or shock will follow; because each hook is disposed to give fire, and neither to receive it. Set one of the bottles down on glass, take it up by the hook, and apply its coating to the hook of the other; then there will be an explosion and shock, and both bottles will be discharged.

6. Vary the experiment, by charging two phials equally, one through the hook, the other through the coating: hold that by the coating which was charged through the hook; and that by the hook which was charged through the coating: apply the hook of the first to the coating of the other, and there will be no shock or spark. Set that down on glass which you held by the hook, take it up by the coating, and bring the two hooks together: a spark and shock will follow, and both phials be discharged.

In this experiment the bottles are totally discharged, or the equilibrium within them restored. The *abounding* of fire in one of the hooks (or rather in the internal surface of one bottle) being exactly equal to the *wanting* of the other: and therefore, as each bottle has in itself the *abounding* as well as the *wanting*, the wanting and abounding must be equal in each bottle. See §. 8, 9, 10, 11. But if a man holds in his hands two bottles, one fully electrified, the other not at all, and brings their hooks together, he has but half a shock, and the bottles will both remain half electrified, the one being half discharged, and the other half charged.

7. Place two phials equally charged on a table at five or six inches distance. Let a cork-ball, suspended by a silk thread, hang between them. If the phials were both charged through their hooks, the cork, when it has been attracted and repelled by the one, will not be attracted, but equally repelled by the other. But if the phials were charged, the one through the hook, and the other (*2*) through the coating, the ball, when it is repelled from one hook, will be as strongly attracted by the other, and play vigorously between them, fetching the electric fluid from the one, and delivering it to the other, till both phials are nearly discharged.

8. When we use the terms of *charging* and *discharging* the phial, it is in compliance with custom, and for want of others more suitable. Since we are of opinion that there is really no more electrical fire in the phial after what is called its *charging*, than before, nor less after its *discharging*; excepting only the small spark that might be given to, and taken from the non-electric matter, if separated from the bottle, which spark may not be equal to a five hundredth part of what is called the explosion.

For if, on the explosion, the electrical fire came out of the bottle by one part, and did not enter in again by another, then, if a man, standing on wax, and holding the bottle in one hand, takes the spark by touching the wire hook with the other, the bottle being thereby *discharged*, the man would be *charged*; or whatever fire was lost by one, would be found in the other, since there was no way for its escape: But the contrary is true.

9. Besides, the phial will not suffer what is called a *charging*, unless as much fire can go out of it one way, as is thrown in by another. A phial cannot be charged standing on wax or glass, or hanging on the prime conductor, unless a communication be formed between its coating and the floor.

10. But suspend two or more phials on the prime conductor, one hanging on the tail of the other; and a wire from the last to the floor, an equal number of turns of the wheel shall charge them all equally, and every one as much as one alone would have been. What is driven out at the tail of the first, serving to charge the second; what is driven out of the second charging the third; and so on. By this means a great number of bottles might be charged with the same labour, and equally high, with one alone, were it not

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In recognition of the 250th anniversary of the birth of Benjamin Franklin, we reproduce Letter IV from his book, *Experiments and Observations on Electricity*. The complete title of the letter was "Letter IV. from Benj. Franklin, *Esq*; in *Philadelphia*, to Peter Collinson, Esq; F.R.S. *London*. *Farther* Experiments *and* Observations *in* Electricity." Letters III and IV were concerned with the Leyden jar. Letter III told of the discovery that the jar has a plus charge on the outside and a minus charge on the inside. Letter IV shows the theoretical usefulness of Franklin's concepts plus and minus.

Letter IV was published in the first edition of *Experiments and Observations on Electricity, made at Philadelphia in America, by Mr. Benjamin Franklin, and Communicated in several letters to Mr. P. Collinson, of London, F.R.S.* (E. Cave, London, 1751). The text given here is reprinted by permission of the publishers from *Benjamin Franklin's Experiments, a New Edition of Franklin's Experiments and Observations on Electricity*, edited, with a critical and historical introduction, by I. Bernard Cohen, published by Harvard University Press, Cambridge, Mass., copyright 1941 by the President and Fellows of Harvard College. The text is based on the fifth English edition (F. Newbery, London, 1774).

that every bottle receives new fire, and loses its old with some reluctance, or rather gives some small resistance to the charging, which in a number of bottles becomes more equal to the charging power, and so repels the fire back again on the globe, sooner in proportion than a single bottle would do.

11. When a bottle is charged in the common way, its *inside* and *outside* surfaces stand ready, the one to give fire by the hook, the other to receive it by the coating; the one is full, and ready to throw out, the other empty and extremely hungry; yet as the first will not *give out*, unless the other can at the same instant *receive in*; so neither will the latter receive in, unless the first can at the same instant give out. When both can be done at once, it is done with inconceivable quickness and violence.

12. So a strait spring (though the comparison does not agree in every particular) when forcibly bent, must, to restore itself, contract that side which in the bending was extended, and extend that which was contracted; if either of these two operations be hindered, the other cannot be done. But the spring is not said to be *charg'd* with elasticity when bent, and discharg'd when unbent; its quantity of elasticity is always the same.

13. Glass, in like manner, has, within its substance, always the same quantity of electrical fire, and that a very great quantity in proportion to the mass of glass, as shall be shewn hereafter.

14. This quantity, proportioned to the glass, it strongly and obstinately retains, and will have neither more nor less though it will suffer a change to be made in its parts and situation; *i.e.* we may take away part of it from one of the sides, provided we throw an equal quantity into the other.

15. Yet when the situation of the electrical fire is thus altered in the glass; when some has been taken from one side, and some added to the other, it will not be at rest or in its natural state, till it is restored to its original equality. – – – And this restitution cannot be made through the substance of the glass, but must be done by a non-electric communication formed without, from surface to surface.

16. Thus, the whole force of the bottle, and power of giving a shock, is in the GLASS ITSELF; the non-electrics in contact with the two surfaces, serving only to *give* and *receive* to and from the several parts of the glass; that is, to give on one side, and take away from the other.

17. This was discovered here in the following manner: Purposing to analyse the electrified bottle, in order to find wherein its strength lay, we placed it on glass, and drew out the cork and wire which for that purpose had been loosely put in. Then taking the bottle in one hand, and bringing a finger of the other near its mouth, a strong spark came from the water, and the shock was as violent as if the wire had remained in it, which shewed that the force did not lie in the wire. Then to find if it resided in the water, being crouded into and condensed in it, as confin'd by the glass, which had been our former opinion, we electrified the bottle again, and placing it on glass, drew out the wire and cork as before; then taking up the bottle, we decanted all its water into an empty bottle, which likewise stood on glass; and taking up that other bottle, we expected, if the force resided in the water, to find a shock from it; but there was none. We judged then that it must either be lost in decanting, or remain in the first bottle. The latter we found to be true; for that bottle on trial gave the shock, though filled up as it stood with fresh unelectrified water from a teapot. – – – To find, then, whether glass had this property merely as glass, or whether the form contributed any thing to it; we took a pane of sash-glass, and laying it on the hand, placed a plate of lead on its upper surface; then electrified that plate, and bringing a finger to it, there was a spark and shock. We then took two plates of lead of equal dimensions, but less than the glass by two inches every way, and electrified the glass between them, by electrifying the uppermost lead; then separated the glass from the lead, in doing which, what little fire might be in the lead was taken out, and the glass being touched in the electrified parts with a finger, afforded only very small prickling sparks, but a great number of them might be taken from different places. Then dextrously placing it again between the leaden plates, and compleating a circle between the two surfaces, a violent shock ensued. – – – Which demonstrated the power to reside in glass as glass, and that the non-electrics in contact served only, like the armature of a loadstone, to unite the force of the several parts, and bring them at once to any point desired: it being the property of a non-electric, that the whole body instantly receives or gives what electrical fire is given to or taken from any one of its parts.

18. Upon this we made what we called an *electrical-battery*, consisting of eleven panes of large sash-glass, armed with thin leaden plates, pasted on each side, placed vertically, and supported at two inches distance on silk cords, with thick hooks of leaden wire, one from each side, standing upright, distant from each other, and convenient communications of wire and chain, from the giving side of one pane, to the receiving side of the other; that so the whole might be charged together, and with the same labour as one single pane; and another contrivance to bring the giving sides, after charging, in contact with one long wire, and the receivers with another, which two long wires would give the force of all the plates of glass at once through the body of any animal forming the circle with them. The plates may also be discharged separately, or any number together that is required. But this machine is not much used, as not perfectly answering our intention with regard to the ease of charging, for the reason given, *Sec.* 10. We made also of large glass panes, magical pictures, and self-moving animated wheels, presently to be described.

19. I perceive by the ingenious Mr. *Watson's* last book, lately received, that Dr. *Bevis* had used, before we had, panes of glass to give a shock (*3*); though, till that book came to hand, I thought to have communicated it to you as a novelty. The excuse for mentioning it here is, that we tried the experiment differently, drew different consequences from it (for Mr. *Watson* still seems to think the fire *accumulated on the non-electric* that is in contact with the glass, p. 72) and, as far as we hitherto know, have carried it farther.

20. The magical picture (*4*) is made thus. Having a large metzotinto with a frame and glass, suppose of the KING (God preserve him) take out the print, and cut a pannel out of it near two inches distant from the frame all round. If the cut is through the picture it is not the worse. With thin paste, or gum water, fix the border that is cut off on the inside of the glass, pressing it smooth and close; then fill up the vacancy by gilding the glass well with leaf gold, or brass. Gild likewise the inner edge of the back of the frame all around, except the top part, and form a communication between that gilding and the gilding behind the glass: then put in the board, and that side is finished. Turn up the glass, and gild the fore side exactly over the back gilding, and when it is dry, cover it, by pasting on the pannel of the picture that hath been cut out, observing to bring the correspondent parts of the border and picture together, by which the picture will appear of a piece, as at first, only part is behind the glass, and part before. Hold the picture horizontally by the top, and place a little moveable gilt crown on the king's head. If now the picture be moderately electrified, and another person take hold of the frame with one hand, so that his fingers touch its inside gilding, and with the other hand endeavour to take off the crown, he will receive a terrible blow, and fail in the attempt. If the picture were highly charged, the consequence might perhaps be as fatal (*5*) as that of high treason, for when the spark is taken through a quire of paper laid on the picture by means of a wire communication, it makes a fair hole through every sheet, that is, through forty-eight leaves, though a quire of paper is thought good armour against the push of a sword, or even against a pistol

bullet, and the crack is exceeding loud. The operator, who holds the picture by the upper end, where the inside of the frame is not gilt, to prevent its falling, feels nothing of the shock, and may touch the face of the picture without danger, which he pretends is a test of his loyalty. – – – If a ring of persons take the shock among them, the experiment is called, *The Conspirators.*

21. On the principle, in *Sec.* 7, that hooks of bottles, differently charged, will attract and repel differently, is made an electrical wheel, that turns with considerable strength. A small upright shaft of wood passes at right angles through a thin round board, of about twelve inches diameter, and turns on a sharp point of iron, fixed in the lower end, while a strong wire in the upper end, passing through a small hole in a thin brass plate, keeps the shaft truly vertical. About thirty *radii* of equal length, made of sash glass, cut in narrow strips, issue horizontally from the circumference of the board, the ends most distant from the center, being about four inches apart. On the end of every one, a brass thimble is fixed. If now the wire of a bottle electrified in the common way, be brought near the circumference of this wheel, it will attract the nearest thimble, and so put the wheel in motion; that thimble, in passing by, receives a spark, and thereby being electrified is repelled, and so driven forwards; while a second being attracted, approaches the wire, receives a spark, and is driven after the first, and so on till the wheel has gone once round, when the thimbles before electrified approaching the wire, instead of being attracted as they were at first, are repelled, and the motion presently ceases. – – – But if another bottle, which had been charged through the coating, be placed near the same wheel, its wire will attract the thimble repelled by the first, and thereby double the force that carries the wheel round; and not only taking out the fire that had been communicated to the thimbles by the first bottle, but even robbing them of their natural quantity, instead of being repelled when they come again towards the first bottle, they are more strongly attracted, so that the wheel mends its pace, till it goes with great rapidity twelve or fifteen round in a minute, and with such strength, as that the weight of one hundred *Spanish* dollars with which we once loaded it, did not seem in the least to retard its motion. – – – This is called an electrical jack; and if a large fowl were spitted on the upright shaft, it would be carried round before a fire with a motion fit for roasting.

22. But this wheel, like those driven by wind, water, or weights, moves by a foreign force, to wit, that of the bottles. The self-moving wheel, though constructed on the same principles, appears more surprising. 'Tis made of a thin round plate of window glass, seventeen inches diameter, well gilt on both sides, all but two inches next the edge. Two small hemispheres of wood are then fixed with cement to the middle of the upper and under sides, centrally opposite, and in each of them a thick strong wire eight or ten inches long, which together make the axis of the wheel. It turns horizontally on a point at the lower end of its axis, which rests on a bit of brass cemented within a glass salt-cellar. The upper end of its axis passes through a hole in a thin brass plate cemented to a long strong piece of glass, which keeps it six or eight inches distant from any nonelectric, and has a small ball of wax or metal on its top, to keep in the fire. In a circle on the table which supports the wheel, are fixed twelve small pillars of glass, at about four inches distance, with a thimble on the top of each. On the edge of the wheel is a small leaden bullet, communicating by a wire with the gilding of the *upper* surface of the wheel; and about six inches from it is another bullet, communicating in like manner with the *under* surface. When the wheel is to be charged by the upper surface, a communication must be made from the under surface to the table. When it is well charged it begins to move; the bullet nearest to a pillar moves towards the thimble on that pillar, and passing by electrifies it, and then pushes itself from it; the succeeding bullet, which communicates with the other surface of the glass, more strongly attracts that thimble, on account of its being before electrified by the other bullet; and thus the wheel encreases its motion till it comes to such a height as that the resistance of the air regulates it. It will go half an hour, and make one minute with another twenty turns in a minute, which is six hundred turns in the whole; the bullet of the upper surface giving in each turn twelve sparks to the thimbles, which makes seven thousand two hundred sparks: and the bullet of the under surface receiving as many from the thimbles; those bullets moving in the time near two thousand five hundred feet. – – – The thimbles are well fixed, and in so exact a circle, that the bullets may pass within a very small distance of each of them. – – – If instead of two bullets you put eight, four communicating with the upper surface, and four with the under surface, placed alternately; which eight, at about six inches distance, completes the circumference, the force and swiftness will be greatly increased, the wheel making fifty turns in a minute; but then it will not continue moving so long. – – – These wheels may be applied, perhaps, to the ringing of chimes (*6*), and moving of light-made orreries.

23. A small wire bent circularly, with a loop at each end; let one end rest against the under surface of the wheel, and bring the other end near the upper surface, it will give a terrible crack, and the force will be discharged.

24. Every spark in that manner drawn from the surface of the wheel, makes a round hole in the gilding, tearing off a part of it in coming out; which shows that the fire is not accumulated on the gilding, but is in the glass itself.

25. The gilding being varnished over with turpentine varnish, the varnish, though dry and hard, is burnt by the spark drawn through it, and gives a strong smell and visible smoke. And when the spark is drawn thro' paper, all round the hole made by it, the paper will be blacked by the smoke, which sometimes penetrates several of the leaves. Part of the gilding torn off is also found forcibly driven into the hole made in the paper by the stroke.

26. It is amazing to observe in how small a portion of glass a great electrical force may lie. A thin glass bubble, about an inch diameter, weighing only six grains, being half filled with water, partly gilt on the outside, and furnish'd with a wire hook, gives, when electrified, as great a shock as a man can well bear. As the glass is thickest near the orifice, I suppose the lower half, which being gilt was electrified and gave the shock, did not exceed two grains; for it appeared, when broken, much thinner than the upper half. – – – If one of these thin bottles be electrified by the coating, and the spark taken out through the gilding, it will break the glass inwards, at the same time that it breaks the gilding outwards.

27. And allowing (for the reasons before given, § 8, 9, 10.) that there is no more electrical fire in a bottle after charging, than before, how great must be the quantity in this small portion of glass! It seems as if it were of its very substance and essence. Perhaps if that due quantity of electrical fire so obstinately retained by glass, could be separated from it, it would no longer be glass; it might lose its transparency, or its brittleness, or its elastivity. – – – Experiments may possibly be invented hereafter, to discover this.

27. We were surprised at the account given in Mr. *Watson's* book of a shock communicated through a great space of dry ground, and suspect there must be some metalline quality in the gravel of that ground; having found that simple dry earth, rammed in a glass tube, open at both ends, and a wire hook inserted in the earth at each end, the earth and wires making part of a circuit, would not conduct the least perceptible shock, and indeed when one wire was electrified, the other hardly shewed any signs of its being in connection with it (*7*). Even a thoroughly wet packthread sometimes fails of conducting a shock, though it otherwise conducts electricity very well. A dry

cake of ice, or an icicle held between two in a circle, likewise prevents the shock, which one would not expect, as water conducts it so perfectly well . – – – Gilding on a new book, though at first it conducts the shock extremely well, yet fails after ten or a dozen experiments, though it appears otherwise in all respects the same, which we cannot account for (*8*).

28. There is one experiment more which surprises us, and is not hitherto satisfactorily accounted for; it is this: Place an iron shot on a glass stand, and let a ball of damp cork, suspended by a silk thread, hang in contact with the shot. Take a bottle in each hand, one that is electrified through the hook, the other through the coating: Apply the giving wire to the shot, which will electrify it *positively,* and the cork shall be repelled: then apply the requiring wire, which will take out the spark given by the other; when the cork will return to the shot: Apply the same again, and take out another spark, so will the shot be electrified *negatively,* and the cork in that case shall be repelled equally as before. Then apply the giving wire to the shot, and give the spark it wanted, so will the cork return: Give it another, which will be an addition to its natural quantity, so will the cork be repelled again: And so may the experiment be repeated as long as there is any charge in the bottles. Which shews that bodies having less than the common quantity of electricity, repel each other, as well as those that have more.

Chagrined a little that we have been hitherto able to produce nothing in this way of use to mankind; and the hot weather coming on, when electrical experiments are not so agreeable, it is proposed to put an end to them for this season, somewhat humorously, in a party of pleasure, on the banks of *Skuylkil* (*9*). Spirits, at the same time, are to be fired by a spark sent from side to side through the river, without any other conductor than the water; an experiment which we some time since performed, to the amazement of many (*10*). A turkey is to be killed for our dinner by the *electrical shock,* and roasted by the *electrical jack,* before a fire kindled by the *electrified bottle*: when the healths of all the famous electricians in *England, Holland, France,* and *Germany* are to be drank in (*11*) *electrified bumpers,* under the discharge of guns from the *electrical battery.*

Notes

1. This was a Discovery of the very ingenious Mr. *Kinnersley,* and by him communicated to me.
2. To charge a bottle commodiously through the coating, place it on a glass stand; form a communication from the prime conductor to the coating, and another from the hook to the wall or floor. When it is charged, remove the latter communication before you take hold of the bottle, otherwise great part of the fire will escape by it.
3. I have since heard that Mr. *Smeaton* was the first who made use of panes of glass for that purpose.
4. Contrived by Mr. *Kinnersley*..
5. We have since found it fatal to small animals, though not to large ones. The biggest we have yet killed is a hen. 1750.
6. This was afterwards done with success by Mr. *Kinnersley.*
7. Probably the ground is never so dry.
8. We afterwards found that it failed after one stroke with a large bottle; and the continuity of the gold appearing broken, and many of its parts dissipated, the electricity could not pass the remaining parts without leaping from part to part through the air, which always resists the motion of this fluid, and was probably the cause of the gold's not conducting so well as before; the number of interruptions in the line of gold, making, when added together, a space larger perhaps than the striking distance.
9. The river that washes one side of *Philadelphia,* as the *Delaware* does the other; both are ornamented with the summer habitations of the citizens, and the agreeable mansions of the principal people of this colony.
10. As the possibility of this experiment has not been easily conceived, I shall here describe it.—Two iron rods, about three feet long, were planted just within the margin of the river, on the opposite sides. A thick piece of wire, with a small round knob at its end, was fixed on the top of one of the rods, bending downwards, so as to deliver commodiously the spark upon the surface of the spirit. A small wire fastened by one end to the handle of the spoon, containing the spirit, was carried a-cross the river, and supported in the air by the rope commonly used to hold by, in drawing the ferry-boats over. The other end of this wire was tied round the coating of the bottle; which being charged, the spark was delivered from the hook to the top of the rod standing in the water on that side. At the same instant the rod on the other side delivered a spark into the spoon, and fired the spirit. The electric fire returning to the coating of the bottle, through the handle of the spoon and the supported wire connected with them.

    That the electric fire thus actually passes through the water, has since been satisfactorily demonstrated to many by an experiment of Mr. *Kinnersley's,* performed in a trough of water about ten feet long. The hand being placed under water in the direction of the spark (which always takes the strait or shortest course, if sufficient, and other circumstances are equal) is struck and penetrated by it as it passes.
11. *An electrified bumper* is a small thin glass tumbler, nearly filled with wine, and electrified as the bottle. This when brought to the lips gives a shock, if the party be close shaved, and does not breath on the liquor.

April 29, 1749.

Significance of "Heat-Activated" Enzymes

Morton N. Swartz, Nathan O. Kaplan, Mary E. Frech

The mechanism of regulation of metabolic routes in the intact cell has been a subject of much interest. It has, of necessity, assumed an even greater significance recently as studies with cell fractions have revealed alternative pathways of metabolism for a given normal metabolite. Mutation, suppressor genes, and new enzyme formation as in the phenomenon of adaptation have recently been explored intensively (*1*) and certainly could provide potent agencies of metabolic control. Another possible mechanism of cellular regulation, the synthesis by the cell of specific enzyme inhibitors, has also been suggested by many workers (*1*). It is this latter concept that we propose to emphasize in this paper (*2*).

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"Heat-Activated" Enzymes

In the course of assays on the pyridine nucleotide content of various microorganisms, it was noted that whereas trichloracetic acid extracts of *Proteus vulgaris* X-19 (strain No. 6380) contained considerable amounts of these nucleotides, extracts prepared from boiled cells showed predominantly nicotinamide riboside and very little diphosphopyridine nucleotide (DPN) or nicotinamide mononucleotide (NMN). Subsequent investigation revealed the presence, in sonic extracts of this organism, of two enzymes (a DPN pyrophosphatase and a 5′-nucleotidase) that were ordinarily present in an inhibited state. Only after these extracts were placed in a boiling water bath for several minutes could any significant activity be shown. The strik-

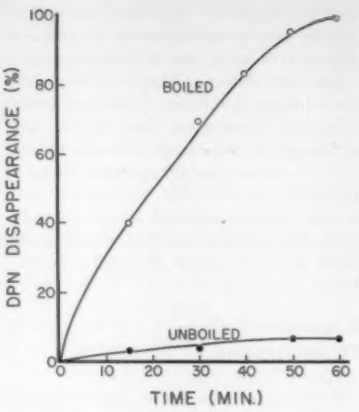

Fig. 1. Effect of heating to 100°C on the activation of an otherwise inactive DPN pyrophosphatase from *Proteus vulgaris*. The reaction mixture contained 0.5 ml of crude enzyme preparation (1 to 6 sonicate in H_2O), 4.3 μmoles of DPN, and 0.08*M* tris buffer (final concentration) at *p*H 7.5 in a final total volume of 3.0 ml. DPN remaining at given times was assayed by the use of the alcohol dehydrogenase method and the reduced DPN was read at 340 mμ. Unboiled enzyme, ●—●; enzyme boiled for 2 minutes, ○—○.

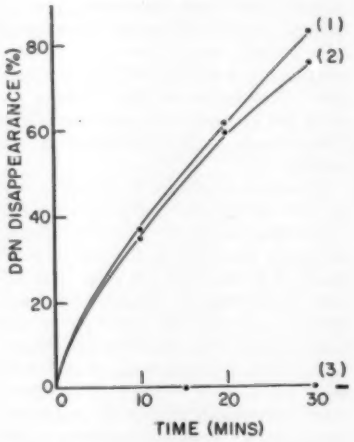

Fig. 2. Requirement for inorganic pyrophosphate to protect enzyme during boiling. The reaction mixture contained 0.5 ml of crude enzyme preparation (1 to 6 sonicate in H_2O) that was boiled for 2 minutes, 2 μmoles of DPN, 0.08*M* tris buffer (final concentration) at *p*H 7.5, and 1 μmole of $CoCl_2$ in a final volume of 1.5 ml. Curve *1*, undialyzed enzyme; curve *2*, enzyme dialyzed for 18 hours against distilled H_2O, then 2 μmoles of inorganic pyrophosphate added to 0.5 ml of enzyme and boiled for 2 minutes; curve *3*, same as curve *2* except that the pyrophosphate was added to the reaction after the enzyme had been boiled. DPN assayed by alcohol dehydrogenase method.

ing heat stability of these enzymes is shown by the fact that even after 15 minutes of boiling 50 percent of the maximum activity (that obtained after 2 minutes of boiling) remains. These enzymes, in the inhibited form, have been purified 20 to 40 fold by some of the common methods of protein fractionation (protamine, acetone, calcium phosphate, and alumina C γ gels), and they still exhibit the phenomenon of "heat-activation." Parenthetically, it might be noted that most of the enzymes in these extracts are not heat stable—for example, alcohol dehydrogenase and nucleoside phosphorylase are markedly heat-labile proteins.

As can be seen in Fig. 1, there is evidence of only slight DPN pyrophosphatase activity in unboiled extracts, whereas after boiling there is a marked capacity to cleave DPN. The explanation of this apparent heat-activation lies in the fortuitous coincidence of a heat-stable enzyme and a heat-labile inhibitor. The ability of the enzyme to withstand boiling appears to require a dialyzable component such as inorganic pyrophosphate. As can be seen in Fig. 2, dialyzed preparations are inactive after boiling, even when inorganic pyrophosphate is subsequently added to the test system. However, when inorganic pyrophosphate (6 μmoles/ml) is added to the enzyme prior to boiling, there is retention of essentially full activity. Neither DPN, NMN, 5′-adenylic acid (5′-AMP), nor metaphosphate will replace pyrophosphate in this protective role. An as yet unidentified organic phosphate compound, which is normally present in extracts of *Proteus vulgaris*, will also afford protection against high temperatures. This compound is in the barium-soluble, alcohol-insoluble fraction of trichloracetic extracts of fresh *Proteus* cells.

Proteus vulgaris sonicates contain roughly a 50-percent excess of free inhibitor—that is, inhibitor not bound to the enzyme. The inhibition of active enzyme by the free inhibitor can be seen in Fig. 3. There is an approximately linear relationship between the amount of inhibitor and the degree of inhibition at the end of 30 minutes. A period of preincubation of the enzyme and inhibitor prior to the addition of substrate would probably have made such a relationship evident earlier in the course of incubation. This inhibitor is nondialyzable, and is, as previously stated, heat labile. Acid treatment (*p*H 1 to 2) for 10 minutes at room temperature destroys the free inhibitor. Bound inhibitor is inactivated by similar treatment, and the enzyme then becomes fully active without boiling. The unbound inhibitor has been purified several fold by alkaline ammonium sulfate and ethanol fractionation. These points of evidence strongly

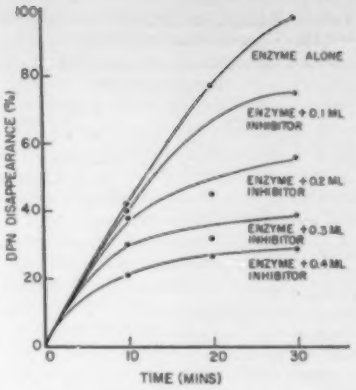

Fig. 3. Effect of free inhibitor on active DPN pyrophosphatase of *Proteus vulgaris*. The reaction mixture contained 0.3 ml of an 18-fold purified enzyme preparation, 2 μmoles of DPN, 0.08*M* tris buffer (final concentration) at *p*H 7.5, and 1 μmole of $CoCl_2$ in a final volume of 1.5 ml. Enzyme boiled with 2 μmoles of inorganic pyrophosphate. Inhibitor fraction dialyzed for 18 hours against distilled H_2O. DPN assayed by alcohol dehydrogenase method.

suggest that the inhibitor is a protein. Furthermore, the purified inhibitor-enzyme complex contains no detectable ribonucleic acid (RNA), and ribonuclease (RNase) does not activate the inhibited enzyme.

In this laboratory, similar enzyme-inhibitor relationships have been found in several other widely divergent types of bacteria: *Mycobacterium butyricum* (*3*), *Bacillus subtilis*, *Proteus morganii*, and *Proteus rettgeri*. These protein inhibitors appear to be quite species-specific, and no cross reactions have as yet been noted (*3*). The heat-activated enzymes from *Mycobacterium* and *Bacillus subtilis* split DPN at the nicotinamide-ribose linkage, yielding adenosine diphosphate ribose and free nicotinamide as products. Milton Kern of this laboratory has found free inhibitor in *Mycobacterium butyricum* in approximately a 10-fold excess over that amount closely bound to the enzyme, and he has achieved some purification of this inhibitor by utilizing ammonium sulfate procedures (*3*). Thus far, heat-activated DPNases have not been found in any higher plant or animal tissues.

The facts that the inhibitor from *Proteus vulgaris* can be split from the enzyme at *p*H 1 to 2 in 10 minutes at room temperature and that it can be inactivated by boiling strongly suggest that these two components are bound by a salt type of linkage rather than through a peptide bond.

The heat-activated pyrophosphatase and the 5′-nucleotidase from *Proteus* are relatively nonspecific in regard to sub-

Table 1. Relative nonspecificity in regard to substrates of heat-activated pyrophosphatase and the 5′-nucleotidase from *Proteus*.

Pyrophosphatase		5′-Nucleotidase	
Split	Not split	Split	Not split
DPN	Thiamine pyrophosphate	5′-AMP	Flavin mononucleotide
DPNH	Metaphosphate	NMN	Glucose-6-phosphate
TPN (slowly)		Ribose-5-phosphate	β-Glycerophosphate
ADP			2′-AMP
ATP			3′-AMP
Deamino DPN			
Adenosine diphosphate ribose			
3-Acetyl pyridine analog DPN			
Inorganic pyrophosphate (slowly)			

strates (Table 1). A purification of the pyrophosphatase completely free of 5′-nucleotidase activity has not thus far been achieved. That these are, nonetheless, two discrete enzymes is evident from the fact that the former has an absolute requirement for cobalt or manganese, whereas the latter has no metal requirement.

A less marked example of the phenomenon of heat activation has been noted previously in the case of the protyrosinase-tyrosinase relationship. Bodine *et al.* (*4–6*) demonstrated that tyrosinase occurs in certain of the lower animals (grasshopper eggs and mealworm larvae) as an inactive material that has been called protyrosinase. The protyrosinase obtained from grasshopper eggs and purified by ammonium sulfate fractionation can be converted into active tyrosinase by treatment with various detergents (sodium oleate, sodium dodecyl sulfate, and others), acetone, or urea. Activation can also be accomplished by the addition of extracts from grasshopper embryos or by heating the protyrosinase fraction to 60° to 70°C. However, the mechanism of the heat activation in this case is thought to be an autocatalytic process rather than the destruction of a heat-labile inhibitor.

A similar phenomenon, activation of an inactive tyrosinase, has been studied in detail recently by Horowitz and Fling (*7*) in *Drosophila melanogaster*. Whereas fresh extracts obtained from adult *Drosophila* exhibit no tyrosinase activity, extracts that have been allowed to stand at 0°C become active. On the basis of a study of the kinetics of activation, it was suggested that tyrosinase formation was most likely an autocatalytic process similar to that in the trypsin-trypsinogen relationship, with the notable exception that the reaction product (tyrosinase), unlike trypsin, takes no part in the autocatalytic reaction. These workers did, however, find a definite tyrosinase inhibitor in fresh extracts of their *Drosophila* system. Although they concluded, from kinetic considerations, that this inhibitor was not responsible for the absence of tyrosinase activity in fresh extracts, they did feel that they had not ruled out some less evident role for it in the activating system.

Enzyme Inhibitors in Mutants

The enzyme-inhibitor mechanism that is suggested by the finding of heat-activated enzymes is also indicated in the studies of Wagner and Guirard (*8*) and Wagner (*9*), who noted that pantothenic acid could be synthesized from beta-alanine and pantoyl-lactone by intact, nongrowing mycelial pads of the wild type of *Neurospora crassa*. However, no synthesis was detectable using pads from a pantothenic acid-requiring mutant that was incapable of utilizing a mixture of these two moieties for growth. It was subsequently shown that pantothenic acid synthesis could be performed by acetone-dried, washed residues from the mutant strain as well as from the wild type. The enzyme isolated from the mutants showed the same chemical and physical properties as that isolated from the wild type with the single exception of a different temperature coefficient of enzymatic activity. Although no mention was made of the isolation of an inhibitor, it is readily conceivable that in the mutant strain the synthetic enzyme, which is definitely present, is kept in an inhibited or inactive state in the whole cell by a specific inhibitor. On fractionation of the cell, this inhibitor is separated from the enzyme or perhaps destroyed. Thus, what at first appeared to be a simple genetic block leading to the loss of a single enzyme may be actually due to an enzyme-inhibitor relationship.

A similar, although less clear, suggestion of a naturally occurring inhibited enzyme has been reported by Gordon and Mitchell (*10*). Cell-free extracts of certain tryptophan-requiring mutants of *Neurospora* contained no demonstrable tryptophan desmolase activity, but similar extracts from the wild type could synthesize tryptophan from indole and serine. After dialysis or ammonium sulfate fractionation, the mutant extracts exhibited considerable tryptophan desmolase activity, although on a dry weight basis this activity never exceeded more than one-half that of the wild type extracts.

Ribonucleic Acids as Enzyme Inhibitors

One type of enzyme in particular has been associated with a natural inhibitor, namely desoxyribonuclease (DNase). DNase inhibitors have been found in yeast (*11*), in streptococci (*12*), and in various animal tissues (*13, 14*). The inhibitor in the case of the streptococcus is a specific RNA, whereas the others are proteins. A very striking example of this enzyme-inhibitor relationship in *Escherichia coli* has been described by Kozloff (*15*). When freshly prepared and assayed, sonic extracts of this organism show essentially no DNase activity. T6r+ phage infected *Escherichia coli* cell sonicates, on the contrary, readily depolymerize DNA. It has been shown that the uninfected cells contain quantitatively as much DNase as the infected cells, but that the enzyme is completely inhibited by a specific RNA of the bacteria. Destruction of the inhibitor by aging the extracts or by treatment with RNase leads to full activation of the enzyme.

A further possible role of RNA as a specific enzyme inhibitor has been tentatively advanced by Rotman (*16*) during the course of studies on the beta-galactosidase of *Escherichia coli* cells. The activity of this enzyme in bacterial extracts has been noted to be about 20 to 100 times what it is in the intact cell. When *Escherichia coli* cells were treated with small amounts of benzene or lysozyme, agents that usually destroy the cell membrane, beta-galactosidase activities of the same magnitude as that in bacterial extracts were observed. A striking parallelism was noted between the increase in enzyme activity and the appearance of RNA break-down products in the suspending medium. The degree of polymerization of the released products ranged from highly polymerized nucleotides to free bases. The material lost appeared to be rather specific, for other cell components such as amino acids were not found among the products. In an attempt to explain the diminished activity in whole cells as compared with the activity in extracts, Rotman has suggested the presence in the intact cell of an RNA-enzyme com-

plex that dissociates on disruption of the cell. Direct demonstration of this RNA-enzyme complex has not as yet been accomplished. This demonstration would seem to be necessary in order to rule out permeability factors as the explanation for the difference between the activities of whole cells and extracts.

Specific Protein Inhibitors

That extracts of adrenal cortex were inhibitory to hexokinase activity in muscle extracts of alloxan diabetic rats has been demonstrated by Colowick *et al.* (*17*). However, the hexokinase activity of normal rat muscle or beef brain extracts was not inhibited on the addition of adrenal cortical extract alone, but it was significantly inhibited by the further addition of a second inhibitory factor, a labile protein fraction from the anterior pituitary. These inhibitions could then be completely removed by insulin. It was suggested that the inhibitory effect of adrenal extracts on diabetic muscle extracts was dependent on the presence in the latter of an inhibitory factor, probably identical with the inhibitory factor in pituitary extracts. A perhaps similar inhibitor for brain hexokinase has been found by Weil-Malherbe (*18*) in the blood of untreated human diabetics. This inhibitor diminished markedly following treatment of the patients with insulin.

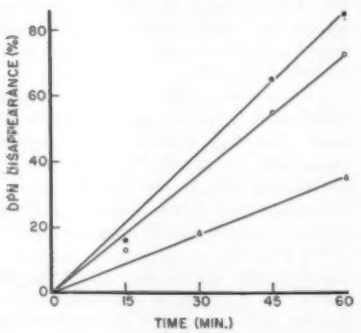

Fig. 4. Effect of nutritional factors on presence of inhibited enzyme. Reaction mixture consisted of 0.1 ml of crude sonicate, 4.3 μmoles of DPN, and 0.08*M* tris buffer (final concentration) at *p*H 7.5. Boiled enzyme from cells grown on minimal medium, ●—●; unboiled enzyme from cells grown on medium containing yeast extract, ○—○; active unboiled enzyme plus 0.1 ml of inhibitor △—△. DPN determined by alcohol dehydrogenase method.

If the role of the natural inhibitor of hexokinase were important and if one could isolate the inhibited enzyme along with the free enzyme without loss of inhibitor, one might expect to find significantly less hexokinase in diabetic tissues than in normal tissues, and perhaps more of the uninhibited enzyme in hypophysectomized animals. Very few comparisons of this sort have been made. Christensen *et al.* (*19*) carefully examined the hexokinase content of hemolyzates of rat red blood cells and were unable to find any significant difference between the activity of normal and of diabetic or hypophysectomized animals. Reiss and Rees (*20*), however, did find that the hexokinase activity extractable from rat brain is higher after hypophysectomy or adrenalectomy than it is before.

The enzyme-inhibitor protein relationship (*21, 22*) has been described in great detail for trypsin inhibitor (various legumes, ovomucoid, pancreas, plasma, colostrum, and *Ascaris*); the relationship is distinct from the autocatalytic conversion of trypsinogen to trypsin. One might teleologically assign a role to the inhibitor from *Ascaris* in inhibiting the action of the pepsin and trypsin that are found in the intestinal tract of the host; but the role of trypsin inhibitor in the other cases is not very evident. The trypsin inhibitor-trypsin complex has been isolated as such from pancreas. This relationship appears to be similar to that of the heat-activated pyrophosphatase in that the two components apparently are held together by secondary rather than by direct chemical bonds. Dissociation occurs outside the *p*H range of complex stability, but within the range, they behave ostensibly as a single protein.

An unusual feature has been noted (*23*) in the conversion of pepsinogen to pepsin. The initial change in the pepsinogen at *p*H 5.4 yields an inactive pepsin-inhibitor compound; and thus it is not, in the strictest sense, an autocatalytic reaction. When the *p*H is reduced below 5, the enzyme-inhibitor compound dissociates into free enzyme and free inhibitor (a large basic polypeptide). Prolonged incubation with pepsin can then cause destruction of the inhibitor.

Nutritional Control of Inhibitors

The existence of certain enzymes in a normally inhibited state could conceivably be a mechanism of cellular control of enzyme action. It would be possible to control enzymatic patterns, then, not only through the limitation of synthesis of an enzyme, but also through the synthesis or lack of synthesis of a specific inhibitory protein or RNA. Indeed, it has been possible to obtain cultures of *Proteus vulgaris* that are essentially free of the inhibitor of the pyrophosphatase by growing the organisms on a medium containing yeast extract rather than on the usual minimal medium (Fig. 4). Crude sonicates of the organism grown on yeast extract showed essentially the same pyrophosphatase activity whether boiled or unboiled. That the enzyme obtained from the organism grown in this way is the same as that obtained from cultures grown on the usual minimal medium is suggested by the remarkable heat stability of both enzymes and by the inhibition of the former by the protein inhibitor obtained from the latter (Fig. 4). The fact that the inhibitor in *Proteus* is subject to nutritional control indicates that protein inhibitors may play a significant role in regulating the metabolic activities of bacteria.

References and Notes

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The ancients tell us what is best; but we must learn from the moderns what is fittest.—BENJAMIN FRANKLIN.

News of Science

Impure Biochemical Products

Many biochemists have expressed concern about the quality of commercial biochemical products, feeling that investigators were unsuspectingly using materials of dubious quality. The governing bodies of the Division of Biological Chemistry of the American Chemical Society and the American Society of Biological Chemists recommended at their spring 1955 meetings that the problem of quality of biochemicals be referred to the Committee on Biological Chemistry, Division of Chemistry and Chemical Technology of the National Research Council. In May of that year, this committee sent questionnaires to all members of the two afore-mentioned biochemical groups in order to obtain opinions and guidance with respect to the magnitude of the problem. Approximately 2200 questionnaires were mailed out and 922 were returned.

On the basis of the large percentage of replies and the nature of the answers and the additional comments, it was clear that there was widespread interest in the present status of commercial biochemicals. Of those replying, 90 percent felt there is a serious need for attempting to improve the quality of biochemicals. A large majority indicated that an NRC committee "representative of academic research and industry" should have responsibility for making efforts toward the betterment of the situation. The same percentage felt that a broad program should be organized for the establishment of minimum specifications of commercially produced biochemicals.

In addition to the routine answers, more than 120 respondents made comments, almost all of which recommended positive action. Many described specific instances wherein faulty commercial biochemicals resulted in serious research difficulties. However, nearly all of the complaints were directed against two firms. Many suggested that, in lieu of reference standards and/or specifications, manufacturers might supply a better description of their products, including information about sources, purification procedures, chemical analyses, and impurities.

The questionnaire also requested suggestions concerning specific biochemicals for which there was need for minimum specifications and/or reference substances. Categories of biochemicals that were named more than 100 times are listed in Table 1.

Table 1. Categories of biochemicals for which there is need for minimum specifications and/or reference substances. The numbers indicate how many times each category was named in answers to the questionnaire.

Category	Specifications only	Reference substances
Nucleic acid	334	251
Amino acids and peptides	243	191
Coenzymes	143	69
Enzymes	173	68
Lipids	136	126
Carbohydrates	125	146

The committee regarded the response to the questionnaire as a mandate for action. It was generally agreed that the best solution to the problem would be the establishment of minimum standard specifications for biochemicals, possibly supplemented with reference substances. However, after a survey of the experience of the American Chemical Society in the establishment of standards for inorganic chemicals, and the experience of the U.S. Pharmacopeia and the National Formulary in similar tasks, it was obvious that such an undertaking would be of very great magnitude and would require such a long time that it would provide little benefit for the near future.

As a first step, it was decided to draw up description sheets for biochemicals and to distribute these in such form that biochemists could obtain them at a nominal cost. These description sheets will cover physical constants, methods of preparation, methods of purification and assay, likely impurities and their methods of determination, information concerning stability and storage conditions, and a list of suppliers.

It was decided to assign the task of drawing up these description sheets to various subcommittees representing specialized areas of biochemistry that would work in close collaboration with the biochemical producers. Because the questionnaire revealed the greatest need for information on nucleic acids, amino acids, and nucleotide coenzymes, committees covering these fields were set up first with George B. Brown, Jesse P. Greenstein, and Nathan O. Kaplan as the respective chairmen. As experience is gained in their work, it is anticipated that subcommittees will be set up later for enzymes, lipids, carbohydrates, and other fields.

This program is being financed partly by a grant from the National Institutes of Health and partly by a Rockefeller Public Service award. Further suggestions will be welcomed by the committee. Address: Committee on Biological Chemistry, Division of Chemistry and Chemical Technology, National Research Council, 2101 Constitution Ave., Washington 25, D.C.

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AAAS Newcomb Cleveland Prize

Seymour S. Cohen, professor of biochemistry at the University of Pennsylvania, received the AAAS Newcomb Cleveland prize on 30 Dec. during the association's annual meeting in Atlanta, Ga. Collaborators in parts of the research for which Cohen was honored were G. R. Wyatt and T. T. Weed, now of Yale University.

The award address was entitled "Molecular bases of the parasitism of some bacterial viruses." An extreme parasitism occurs in the infection of *Escherichia coli* by the T2, T4, or T6 bacteriophages. These viruses prevent bacterial growth and division, eventually lysing the cells.

Cohen has shown that these viruses inhibit the synthesis of bacterial nucleoprotein and enzymes. Cell synthesis is directed almost exclusively to the production of virus desoxyribonucleic acid (DNA) and virus protein. Virus DNA contains a new pyrimidine base, 5-hydroxymethyl cytosine (HMC), in contrast to host nucleic acids which contain cystosine. Virus infection compels the conversion of cytosine to HMC, making the former unavailable for the synthesis of cell nucleic acids and shifting nucleic acid synthesis to that characteristic of virus—that is, DNA containing HMC.

Cohen has demonstrated that hydroxymethylation is an irreversible trap for cytosine. Once formed, HMC and HMC desoxyriboside are practically inert to bacterial enzymes which degrade cyto-

sine and derivatives. Furthermore, the presence of HMC in virus DNA stabilizes this polymer to depolymerases and phosphatases. This is owing to the addition of glucose to the hydroxymethyl group, which then inhibits cleavage of phosphate esters of HMC desoxyriboside. Thus the formation of HMC not only serves to switch host metabolism to virus production, but associated structures assist the survival of viral DNA in the host.

North Pacific Survey

In July, August, and September 1955 nearly 20 agencies from Japan, Canada, and the United States combined their facilities to make a great synoptic oceanographic survey (called NORPAC) of the North Pacific Ocean [*Science* **121**, 794 (1955)]. Such coverage has long been needed to provide background knowledge of hydrography for studies of fisheries problems. Approximately 20 large vessels and many small ones participated in the program.

The enormous gyral of the Pacific Ocean had been studied before in piecemeal style, but the independent efforts were either made on too small a scale or else were made over too long a period of time for their results to be used effectively in determining the currents and transport of water. Contiguous cruises made by the Pacific Oceanographic Group in Canada and the California Cooperative Oceanic Fisheries Investigations in August 1950, and jointly by the latter and the Pacific Oceanic Fishery Investigations of the U.S. Fish and Wildlife Service in Hawaii in January 1954, had confirmed the belief that great advantages were gained by studying large oceanic areas in short periods of time because a survey of short duration would avoid inclusion of seasonal changes in ocean currents in the measurements.

The proposal for a large-scale, short-duration oceanographic survey of the North Pacific Ocean was made at the fifth Pacific Tuna Conference in November 1954, which was attended by all the agencies that subsequently took part in the cruise except for those from Japan, and it was immediately decided to try to make such a survey. Various Japanese scientists were asked whether or not the Japanese would participate, and they answered through K. Suda of the Japanese Hydrographic Office, at once agreeing to take part.

At intervals of from 20 to 200 miles, water sampling bottles and thermometers were lowered from the surface to depths varying from 1200 to 6000 meters. Water samples were drawn and immediately measured for dissolved oxygen content and inorganic phosphate and, in some cases, for silicate. Additional samples were drawn for later measurement ashore of salinity, deuterium, and level of radioactivity.

Some vessels carried sonic apparatus so that the depth of the ocean could be continuously recorded. Transparency was measured by lowering secchi disks on all daylight stations. Using towed geomagnetic electrokinetographs, eight of the survey vessels recorded surface currents. At intervals between hydrographic casts, temperature-and-depth data were obtained by lowering bathythermographs.

The biological program consisted of several parts. Net hauls of zooplankton and phytoplankton were taken from various depths down to 1000 meters; small creatures such as saury, squid, sunfish, and others were observed and netted at night while the vessel was not under way; many vessels trolled; and daylight observations of birds, fish, and mammals were made and recorded. It is anticipated that the results of this survey will be immediately useful to two new pelagic fishery investigations in the North Pacific. These are the offshore salmon investigations being conducted by Japan and the United States under the auspices of the North Pacific Fishery Treaty and the offshore albacore studies that are being carried out by the Pacific Oceanic Fishery Investigations in Hawaii and the fishery agencies of California, Oregon, and Washington. These investigations have already discovered large offshore concentrations of salmon and albacore. The ecological basis for the summer distribution of these populations should be revealed by analysis of the observations made during NORPAC.

In area covered, number of stations occupied, number of observations made, and in samples collected, this is the largest oceanographic survey ever carried out in such a short period (most of the data were taken in August, although a few ships began in July and did not return until mid-September). Processing of the hydrographic data has begun, and it is expected that the preliminary results of the observations will be available in March 1956.

African Honey-Guides

A long-term study of the behavior of honey-guides, African birds distantly related to the American woodpecker, is described by Herbert Friedmann, curator of birds at the U.S. National Museum, in a bulletin just issued by the Smithsonian Institution. The birds guide men, baboons, and ratels (honey badgers) to the nests of wild honeybees.

Friedmann has observed at least 23 instances of the guiding habit and has collected much other well-authenticated data from African associates. Friedmann describes the behavior, which he says is purely instinctive, as follows:

"When the bird is ready to begin guiding, it either comes to a person and starts a repetitive series of churring notes or it stays where it is and begins calling. . . . These churring notes are very similar to the sound made by shaking a partly full, small matchbox rapidly sidewise. . . .

"As the person comes to within 15 or 20 feet, . . . the bird flies off with an initial conspicuous downward dip, and then goes off to another tree, not necessarily in sight of the follower, in fact more often out of sight than not. Then it waits there, churring loudly until the follower again nears it, when the action is repeated. This goes on until the vicinity of the bee's nest is reached. Here the bird suddenly ceases calling and perches quietly in a tree nearby. It waits there for the follower to open the hive, and it usually remains there until the person has departed with his loot of honeycomb, when it comes down to the plundered bees' nest and begins to feed on the bits of comb left strewn about. The time during which the bird may wait quietly may vary from a few minutes to well over an hour and a half."

The bird appears to have a peculiar ability to digest wax. Friedmann, with various collaborators, is now carrying out a study of the mechanism of wax digestion.

Australopithecines

Chiefly on the basis of the three hipbones thus far discovered, it has been widely assumed that the early Pleistocene primates of South Africa, the Australopithecines, were fully erect terrestrial bipeds that walked essentially like man. Using the split-line technique, Lois W. Mednick has recently compared the hipbones of modern man and chimpanzee and has applied the results of her study in an analysis of the Australopithecine pelvis [*Am. J. Phys. Anthropol.* **13**, 203 (June 1955)].

The iliac tubercle and associated pillar of bone are well developed in man but lacking in the chimpanzee. These structures, which are regarded as of prime importance in maintaining an erect, bipedal posture, are but poorly developed in the Australopithecines. The findings suggest that the Australopithecines could not balance themselves as well as man and were still in the process of adapting to erect progression.

Mednick thinks that these animals may represent a transitional stage of bipedal adaptation that never reached its culmination; on the other hand, she thinks it is also possible that they may represent a stage that developed into man. It may

be noted that this new evidence—which indicates that these interesting but controversial fossils were not fully adapted, truly erect bipeds—agrees with other evidence from the pelvis, notably the structure of the ischium and the iliac sacral surface, as well as with evidence that has been secured by detailed studies of other parts of the postcranial skeleton and the skull.—W. L. S. JR.

News Briefs

■ To enable the countries of Asia to study the social implications of the economic changes now taking place there—in particular, technological improvements and industrialization—the United Nations Educational, Scientific and Cultural Organization is to open a regional research center at Calcutta this month. Details of this proposal, first made at the Montevideo General Conference last December, have been approved by the executive board of UNESCO.

The Indian Government, which offered to act as host country, has promised to contribute $35,000 a year to this center, which will be financed from UNESCO's normal budget. The cost of the first year's operation will be about $150,000.

Ten Asian countries sent delegates to the advisory meeting that was held in New Delhi last September at which recommendations on the functions of the center were formulated. Afghanistan, Burma, Ceylon, India, Indonesia, Nepal, Pakistan, the Philippines, Thailand, and the Malaya-British Borneo group of associated member states will take part in the work of the new center, which is to be known as the Research Center on the Social Implications of Industrialization in Southern Asia. It is also open to other countries of South Asia. Not only will this center undertake active research, but it will also serve as a training center for social scientists; thus it will provide participating countries with the resources for future study and research.

■ The National Science Foundation and the National Academy of Sciences–National Research Council have recently published *Soviet Professional Manpower: Its Education, Training, and Supply* by Nicholas DeWitt of the Russian Research Center, Harvard University. The study, based largely on published Soviet sources, was undertaken with the support of the NAS–NRC and the National Science Foundation. It should prove useful to those who wish to obtain information about the role of the Soviet professional labor force. Information and data are given on the operational features of the Soviet educational system, factors affecting the quality of general and specialized education during the last three decades, and the supply of trained specialized manpower in the U.S.S.R.

Scientists in the News

JESSE E. HOBSON, director of the Stanford Research Institute, has announced that he will resign early in 1956. Another change at SRI is the appointment of JOHN I. YELLOTT as an assistant director. For the past 10 years he has been director of research for the Locomotive Development Committee of Bituminous Coal Research, Inc. of New York.

Yellott will head the development of the institute's solar energy research program in cooperation with the Association for Applied Solar Energy. He will be posted in Phoenix, Ariz., where he will operate out of SRI's Mountain States Division offices.

BUELL W. BEADLE has joined Southwest Research Institute's staff as manager of biochemistry research. He was formerly associated with George W. Gooch Laboratories in Los Angeles, Calif., where he was executive vice-president and general manager of the laboratories that serve the feed, food, fertilizer, and fats and oils industries.

BEVERLY W. DUNCAN, formerly chief metallurgist for Alloy Precision Castings Company, Cleveland, Ohio, has been appointed head of research and development for Misco Precision Casting Company, Whitehall, Mich.

JOHN BIESANZ, associate professor of sociology and anthropology at Wayne University, has been awarded a Smith-Mundt professorship of sociology and anthropology at the University of San Carlos in Guatemala City, Guatemala. He will leave at the end of this semester and will return to Wayne in September.

FRANCIS E. COUNCIL, a colonel in the Army Medical Corps, has been appointed Army deputy director of the Armed Forces Institute of Pathology. The appointment has been made pending the retirement of DWIGHT M. KUHNS. Council will continue serving as chief consultant in pathology and allied sciences to the Surgeon General of the Army.

ROLAND J. DAHL, who since 1930 has been associated with the E. R. Squibb and Sons division of the Olin Mathieson Chemical Corporation, has been appointed director of research and development. He succeeds William A. Feirer, who has resigned from active duty and who becomes a special consultant to the Squibb division.

PERCY W. OTT is retiring as a member of the Ohio State University engineering faculty after 36 years of service. For 18 years he has been chairman of the department of engineering mechanics. Another retirement is that of LOUIS H. BURGWALD, who has been in the dairy technology department for 26 years. Each man has received the title of professor emeritus.

DAVID G. FREIMAN, associate professor of pathology at the University of Cincinnati, will resign on 31 Jan. to become pathologist-in-chief and director of laboratories at Beth Israel Hospital, Boston, Mass., and clinical professor of pathology at the Harvard University Medical School.

EVERETT L. ELLIS, associate professor of wood technology at the University of Idaho, has been appointed associate professor of wood technology in the University of Michigan School of Natural Resources, effective in the fall of 1956.

D. F. WATERHOUSE, assistant chief of the division of entomology, Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia, is visiting the Connecticut Agricultural Experiment Station for 6 months. He will conduct original investigations on the digestion of wax by insects.

RALPH E. BENNETT, formerly engaged in microbiological research at the University of Pennsylvania, has been appointed head of the microbial biochemistry laboratories at the Squibb Institute for Medical Research, New Brunswick, N.J.

BETTY J. MEANS, who for a number of years supervised the sterility testing program in the control laboratories of Merck and Company, has joined the microbiology staff at the Food Research Laboratories, Inc., Long Island City, N.Y.

ISAAC RUCHMAN, formerly an assistant professor in the department of bacteriology, University of Cincinnati, has joined the research laboratories of the Wm. S. Merrell Company, Cincinnati, Ohio.

EMORY LEON CHAFFEE, emeritus professor of physics and former chairman of the department of engineering, science, and applied physics at Harvard University, has joined the staff of Frederick G. Keyes, Inc., Cambridge, Mass., as a consulting associate.

RICHARD J. STULL, who since 1948 has held a statewide post in the University of California as director of hospitals and

infirmaries, has been named vice president, medical sciences. In this newly created position, Stull will have administrative responsibility for all of the university's teaching, research, and service programs in the health sciences.

J. B. DE C. M. SAUNDERS, chairman of the anatomy department at the medical school in San Francisco, has been appointed dean. He succeeds to the deanship vacated by the resignation in June 1954 of Francis S. Smyth, who continues to serve as professor of pediatrics and director of the Indonesia Project.

VINCENT DU VIGNEAUD, winner of the 1955 Nobel prize in chemistry, will deliver the fourth annual Dakin memorial lecture at Adelphi College on 21 Mar. The lecture is sponsored by Adelphi's chemistry department and is open to the public without charge.

R. R. A. COOMBS, assistant director of research in the department of pathology, Cambridge University, England, has been appointed editor-in-chief of the *International Archives of Allergy and Applied Immunology*.

HENRY GROPPE, former assistant director of development for the Monsanto Chemical Company's plastics division at Texas City, Tex., has joined Joseph R. Mares in his practice as an industrial chemical consultant. The firm's office is in Houston, Tex.

JULES H. MASSERMAN, professor of psychiatry and neurology at Northwestern University, returned recently from a 6-week lecture tour through South America under the auspices of the World Health Organization.

BEN S. MORRIS, director of the National Foundation for Educational Research in England and Wales, will attend the international conference convened by the American Educational Research Association in Atlantic City, N.J., 13–21 Feb. Thereafter he will be in the United States for a few weeks, when he hopes to visit a number of educational research centers and to lecture on current educational research in England. Morris is particularly interested in selection problems, in theory and practice of educational guidance, and in the mental health and the emotional aspects of learning.

ROBERT L. MURRAY, chairman of the board of directors and chief executive officer of Hooker Electrochemical Company, Niagara Falls, N.Y., has been chosen to receive the Chemical Industry medal for 1956 "for conspicuous services to applied chemistry." Announcement of the award was made by the American Section of the Society of Chemical Industry, donor of the medal. Formal presentation to Murray will be made at a meeting of the American Section following a dinner in the medalist's honor at the Waldorf-Astoria Hotel, New York, on 27 Apr.

Recent Deaths

FERNAND E. D'HUMY, Chappaqua, N.Y.; 82; leader in field of communication; former vice president in charge of development and research of the Western Union Telegraph Company; 22 Dec.

MARTIN S. GARRETSON, Dunellen, N.J.; 89; retired curator of the New York Zoological Society; secretary-treasurer of the American Bison Society and a leader in the fight for preservation of the bison; 21 Dec.

JOSEPH A. LEDUC, Montreal, Canada; 78; emeritus professor of medicine of the University of Montreal; 21 Dec.

HOWARD W. LUNDY, Montclair, N.J.; 45; scientific director of the Muscular Distrophy Associations of America, Inc.; former assistant professor of bacteriology and public health at the State College of Washington; health education consultant with the Institute of Inter-American Affairs; 22 Dec.

JACOB MEYER, Chicago, Ill.; 61; professor of medicine at the University of Illinois Medical School, Chicago, Ill.; 17 Dec.

ROY W. MINER, Stonington, Conn.; 80; curator emeritus of marine life at the American Museum of Natural History, New York; 13 Dec.

HARRY E. NEWCOMER, Washington, D.C.; 57; retired assistant physicist at the National Bureau of Standards, Washington, D. C.; 23 Dec.

THOMAS J. PRESTON, South Orange, N.J.; 93; former professor of archeology at Princeton University, Princeton, N.J.; former president pro tem of Wells College; 25 Dec.

Grants, Fellowships, and Awards

■ The College of Forestry of the State University of New York expects to offer 24 assistantships for the college year 1956–57. Stipends vary from $900 to $1350 for a 9- or a 12-month period. Assistantship holders are excused from paying tuition and laboratory fees of about $350 per year.

Recipients are required to assist in teaching and research work for a maximum of 15 hours per week. Assistants may pursue studies leading to the master of forestry, master of science, and doctor of philosophy degrees.

Scholarships. Tuition scholarships for deserving out-of-state students also are available in limited number. These cover tuition and fees to the amount of $350 per year.

Research fellowships. Specially qualified applicants will be considered for fellowships sponsored by industry, research foundations, and Government agencies that the college awards for work on assigned research projects. Recipients are required to devote full time, except for course work, to these projects. Conditions of awards vary with sponsorship.

The industrial and other sponsored research fellowships carry stipends from $1500 to $2000. Holders of these fellowships are also excused from paying tuition and laboratory fees. These awards are usually offered in such fields as wood chemistry, polymer and plastics chemistry, pulp and paper technology, wood technology and utilization, preservation and pathology.

Research fellowships are also awarded in relation to the general program of research of the college. These fellowships cover all fields of forestry offered by the college.

Applications for assistantships, research fellowships, or scholarships for the year 1956–57 should be made *not later than 15 Mar.* Further information may be obtained from the Associate Dean for Graduate Studies, State University of New York College of Forestry, Syracuse, N.Y.

■ The Dupont Company has allocated more than $900,000 for grants to some 100 universities and colleges in its annual program of aid to education. This support, which is for the next academic year, is a substantial increase over the $800,000 in gifts made for this year. All of the increase and nearly half of the entire new program is for the improvement of teaching in colleges and universities and in high schools. The grants will support science and mathematics as well as other subjects.

The fund for aid to teaching totals $445,000, including $200,000 to aid undergraduate teaching in 50 privately supported colleges. Of this amount, $125,000 is for advancing the teaching of chemistry, supplemented by $75,000 to strengthen the teaching of other subjects important in the education of scientists and engineers. The grants for teaching chemistry have been in effect this year and are being renewed for next year. The supplementary grants are being given for the first time.

The company's program for the advanced training of high-school teachers of science and mathematics is nearly doubled. Grants totaling $130,000 are provided for fellowships for active and prospective teachers for summer sessions and for the next academic year. The company announced the award of 134 teachers' fellowships to eight institutions

for the coming summer and of 22 fellowships to nine institutions for the academic year.

Du Pont has also expanded its grants for postgraduate teaching assistantships to $115,000. There are 30 of these grants, chiefly in chemistry, and they are shared by 28 universities. Purpose is to improve instruction in the universities and to encourage postgraduate students to enter teaching careers.

Under its longer standing plans, the company is granting $270,000 to universities for fundamental research and $190,000 for postgraduate fellowships in science and engineering. Included in the authorization for research are grants-in-aid of $15,000 each to ten universities and $10,000 each to seven others.

There are also summer research grants of $1500 each to 20 other universities. These are to enable younger staff members of university chemistry departments to undertake research of their own during the summer months.

Under the program of postgraduate fellowships in scientific fields, the company is awarding 52 for the next academic year. There are 20 fellowships in chemistry, 16 in chemical engineering, six in biochemistry, four each in physics and mechanical engineering, and two in metallurgy.

■ Massachusetts Institute of Technology has announced a national competition for fellowships for high-school teachers of chemistry, physics, and biology throughout the United States to attend a special program at M.I.T. during the summer of 1956. Assistance from the Westinghouse Educational Foundation will make possible a total of 80 fellowships to help meet the costs of attending the special program.

This year's fellowship winners will participate in a 6-week course of study at M.I.T. from 2 July through 10 Aug. Designed by a special faculty committee, this program will provide a review of fundamental subject matter in physics, chemistry, and biology, and a survey of recent scientific developments not only in these fields but also in meteorology, geology, and aeronautical engineering.

Further information and application blanks may be obtained from the Summer Session Office, Massachusetts Institute of Technology, Cambridge 39. Applications must be filed *by 1 Apr.*

■ The Radcliffe Graduate School of Arts and Sciences invites applications for the Helen Putnam fellowship for advanced research, a postdoctoral resident fellowship for women. The recipient may use the research facilities at Harvard University. Investigations may be in any area related to genetics or mental health, including psychology, child development, and other fields of social science.

The stipend will be $3000 a year, with possibility of renewal. Application blanks may be obtained from the Secretary of the Graduate School, Radcliffe College, Cambridge 38, Mass. Completed applications should be returned *not later than 1 Apr.*

In the Laboratories

■ The General Electric Company has put a new $1.5-million laboratory into operation at the Hanford atomic plant to seek water treatment methods that will permit greater production of fissionable material. The goal is to find economical ways of chemically treating water from the Columbia River so that it can be used to cool Hanford reactors operating at higher power than at present.

Since it has been found that corrosion of reactor tubes and fuel elements increases as reactor power increases, research is needed to determine methods of decreasing this corrosion by improvement of techniques for treating coolants.

Further, impurities in coolants become radioactive when they are exposed to intense neutron bombardment. A conservative limit has been set on this radioactivity so that the effluent will not damage aquatic life.

The new laboratory will be in operation 24 hours a day. It provides large-scale facilities for experiments in filtering and chemical treatment and for pumping water through simulated hydraulic systems and test channels in a nearby reactor. Equipment for corrosion and hydraulic studies is included. Also, indoor and outdoor fish troughs and ponds are available to expose aquatic life to various concentrations and types of reactor effluent.

■ The Atomic Energy Commission has extended until 1 Oct. the period of time for private industry to submit proposals for production of refined uranium compounds. Further, 1 Apr. 1959 is the new date for deliveries to begin. Last fall the AEC announced the program, setting 31 Mar. 1956 as the date for receiving proposals and July 1958 as the date for deliveries to begin.

The commission also added uranium trioxide to the list of compounds acceptable as a final product. Originally, the AEC requested proposals for the production of either uranium tetrafluoride or uranium hexafluoride, with uranium trioxide acceptable on an interim basis pending completion of facilities for the production of the uranium tetrafluoride or uranium hexafluoride. Now uranium trioxide is acceptable both as an interim and as a final product.

To assist in the preparation of proposals, the AEC will make available classified technology relating to the production of uranium compounds to those applicants eligible to receive classified data under the access permit procedure. Information about obtaining access permits, as well as further details relative to the preparation of proposals, can be secured by writing to Mr. Harold L. Price, Director, Division of Civilian Application, U.S. Atomic Energy Commission, Washington 25, D.C.

Miscellaneous

■ A 6-page illustrated folder, "Medical engineering—new area for research and development," is available on request from the Office of Information Services of New York University. The booklet is a reprint of an article that appeared in the November issue of *Research and Engineering*. Written by Renato Contini, research coordinator in the N.Y.U. Engineering Research Division, the article discusses the historical development of medicine and engineering, the areas of present cooperation between them, and the potentialities for further cooperation.

■ A new monthly publication listing recent reports of research by the Atomic Energy Commission has now been made available, according to the Office of Technical Services, U.S. Department of Commerce. Nonclassified reports of AEC research are listed in a separate section of the OTS monthly publication, *U.S. Government Research Reports*, as they are released. The demand for these AEC reports has been so strong that it was decided to reprint the AEC section of this publication to make wider dissemination of this information possible. The reprints will be available monthly from OTS starting with a November issue, which may be obtained from OTS, Department of Commerce, Washington 25, or from any of its 33 field offices, for 10 cents.

Last August OTS undertook a stepped-up program to release AEC reports and at that time 961 were released. Since then an average of 100 have been released each month. These reports cover many areas of scientific and industrial interest, including chemistry, geology, metallurgy, mineralogy, ceramics, instrumentation, physics, and reactor technology. They range from general studies such as "Fission products utilization" to such titles as "Radiation stability of plastics and elastomers," "Surface preparation of zirconium for brazing," and "The titanium-vanadium system."

Reports and Letters

Nitrogen Secretion in the Swimbladder of Whitefish

Hüfner reported in 1892 (*1*) that the swimbladder of whitefish (*Coregonus acronius*) that had been netted on the bottom of the Bodensee at a depth of 60 to 80 m contained 99 percent or more "nitrogen"—that is, unabsorbable gases. The fish were alive and distended when they reached the surface and from the amount of gas they contained one may calculate that they were in neutral buoyancy at the bottom. They could not, therefore, have filled their swimbladders with air at the surface, but the "nitrogen" must have been deposited in the swimbladder at the bottom—that is, against a pressure gradient of 5 to 7 atm (*2*). Hüfner's startling discovery was verified by Saunders (*3*) in a large series of determinations on several species of deepwater physostome fishes in Lake Huron and adjoining waters.

A similar situation exists in deep-sea physoclist fishes, in which the nitrogen tension frequently reaches 10 atm or more, although in this case the main pressure is due to oxygen. Organic gases, if any, are present only as traces (*4*), and the argon-to-nitrogen ratio is near to that in air (*5*). For physostome fishes there is no knowledge so far concerning the identity of the gas they secrete, except that it is unabsorbable. We have therefore analyzed the swimbladder gas of a deepwater coregonid (*Leucichthys johannae*) from Lake Michigan, obtaining information concerning its amount and its content of carbon dioxide, oxygen, nitrogen, organic gases, and argon (*6*).

We were able to secure samples from live fishes as they were hauled aboard the boat. The fish were caught in gill nets set at the bottom at a depth of 100 m. Only lively and externally intact fishes were used. Gas was drawn into 20-ml syringes, lubricated with concentrated lithium chloride, and analyzed in the ½-ml analyzer (*7*), accurate to ±0.015 percent, for CO_2, O_2, and "N_2." Organic gases were analyzed by fitting a combustion chamber onto the oxygen side of the Henderson-Haldane analyzer. Checks on air containing known amounts of acetylene gave satisfactory results. The argon-to-nitrogen ratio was determined by mass spectrometer at the Johns Hopkins University School of Medicine (*8*).

Buoyancy check. The gas from four fishes was pooled; it measured 188 ml. These four fishes, emptied of gas and suspended under water, weighed 15 g. Hence, neutral buoyancy would occur at a total pressure of nearly 12 atm. This is close enough to the total pressure of 11 atm at which the fishes were caught to indicate that the gas must have been deposited in the swimbladder at that depth.

Absorption analysis. The results of analyses of swimbladder gas from ten fishes taken at 100-m depth are given in Table 1. It will be seen that, in agreement with Saunders' data from similar or greater depths, the swimbladder gas in our species consisted of more than 99 percent nonabsorbable gases.

Combustion analysis. Gas from ten fishes was pooled over concentrated calcium chloride and 10-percent tank oxygen was added. Combustion resulted in zero shrinkage and zero CO_2 production. In a second lot of four pooled samples, the gas shrank in triplicate analyses by 0.10, 0.06, and 0.04 percent, with increments in CO_2 of 0.04, 0.00 and 0.01 percent. There is therefore less than 0.1 percent of combustible gas, if any, in the swimbladder, and the nonabsorbable gas consists of nitrogen and argon, with, very likely, traces of other noble gases.

Argon-nitrogen analysis. The argon-to-nitrogen ratio is of particular interest inasmuch as it may give some clue concerning how the nitrogen gets into the swimbladder. If the nitrogen were released from some chemical compound so that it attains a pressure of, say, 10 atm above the nitrogen tension in the water (0.8 atm), the argon would be left behind, so that the argon-to-nitrogen ratio in a swimbladder from a depth of 100 m would be only one-tenth of that in air—that is, 0.1 percent (*9*). Actually, we find that the argon-to-nitrogen ratio averages 0.92 percent, which is very close to the 1.17 percent in air and water (Table 1). In our whitefishes, the argon tension in the swimbladder was accordingly 8 to 10 times higher than it was in the water. These findings, which agree with the data from deep-sea physoclists, lend little support to the idea of a nitrogen secretion by chemical means, whether produced by the fish itself or by bacteria. We observed no free gas in the intestines of the fishes.

The swimbladder gas in our deepwater coregonid consists of some 99-percent pure nitrogen gas. This has been brought into the swimbladder against a pressure gradient of 10 atm by some process that is capable of concentrating argon as well. A similar nitrogen-argon transport is realized in deep-sea physoclist fishes, in which, however, the main action is oxygen secretion. Vascular *rete* structures have not been described for coregonid fishes, and the question therefore arises whether the epithelial cells lining the swimbladder might be the site for the secretion.

The deposition of nitrogen and argon against considerable concentration gradients in the swimbladder of fishes sug-

Table 1. Composition of the swimbladder gas in whitefish taken at a depth of 100 m (combustible gases 0.00 to less than 0.10 percent).

Fish	CO_2 (%)	O_2 (%)	$N_2 + A$ (%)	Pressure of $N_2 + A$ (atm)	Ratio ($100A/N_2$)
1	0.24	0.01	99.75	11.0	
2	2.13	0.20	97.67	11.0	
3	0.47	0.00	99.53	10.9	
4	0.52	0.28	99.20	10.9	1.16
5	0.64	0.21	99.15	10.9	0.69
6	1.13	0.07	98.80	10.9	0.67
7	0.27	0.02	99.71	11.0	1.08
8	0.31	0.02	99.67	11.0	0.96
9	0.73	0.01	99.26	10.9	0.71
10	0.61	0.01	99.38	10.9	1.17
Air	0.03	20.94	79.03	0.79	1.17

gests, in the absence of other explanations, the possibility of a cellular mechanism for the secretion of inert material.

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15 July 1955

New Scheme for Performance of Osmotic Work by Membranes

There is now a wealth of literature dealing with the fact that a variety of cell membranes are able to remove inorganic salts and other neutral organic molecules from dilute solutions and transport them through the membrane into more concentrated solutions (*1*). This "active transport" of molecules against a concentration gradient requires energy that is thought to be provided by the metabolic activity in the neighborhood of the membrane. Several proposals have been made regarding the mechanism of active transport (*2*), all of which are possible, but perhaps none of which is the simplest mechanism that could be described.

It is the purpose of this communication to suggest that in the simplest case, active transport can be performed by a single enzyme. This enzyme, which acts as a "carrier" of the transported species, is confined between two closely spaced semipermeable membranes and is engaged in the conversion of a substrate S into products P. Let us examine the state of affairs when a substrate diffuses into the enzyme "sandwich" from the left-hand side. Inside the membrane, the enzyme-substrate complex ES is formed and diffuses to the right, driven by its own concentration gradient. If the ES complex binds another ion or molecule, this species will be transported to the right as a "passenger." On the way over to the right side of the membrane, the ES complex is broken down, forming the products and the free enzyme E which we suppose for the moment can no longer bind the "passenger species" in question. Thus, the passenger species is continually being removed from the left and deposited on the right in the membrane. In the steady state, the back diffusion of the free passenger species is just balanced by the flux of ES (with bound passenger molecules) to the right.

If the kinetics can be adequately described by the Michaelis-Menton expression, we have (*3*):

$$S + E \underset{k_2}{\overset{k_1}{\rightleftarrows}} (ES) \xrightarrow{k_3} E + P$$

where S, E, and ES denote the molar concentration of the species. When a steady state has been attained, we have the following equations for the conservation of mass:

$$D_S(d^2S/dx^2) - k_1SE + k_2(ES) = 0 \quad (1)$$

$$D_{ES}[d^2(ES)/dx^2] + k_1SE - k_2(ES) - k_3(ES) = 0 \quad (2)$$

$$D_E(d^2E/dx^2) - k_1SE + k_2(ES) + k_3(ES) = 0 \quad (3)$$

where D_S, D_E and D_{ES} represent the diffusion constants of the species.

Although the following assumptions are probably not necessary for the operation of the transporting membrane, we make them in order to solve this set of equations easily: (i) k_2 is small and can be neglected; (ii) the concentration of free enzyme inside the membrane is not appreciably affected by reaction with the substrate. This is comparable to the assumption of negligible atmosphere depletion in flame kinetics (*3*), a problem that has recently been solved by Smith (*4*). The solution to Eq. 1 becomes

$$S = S_0\exp(-cx)\,;\; c^2 = k_1E/D_S \quad (4)$$

Assuming that all the substrate that enters the membrane is converted to P, we have a solution to Eq. 2:

$$(ES) = D_Sc^2S_0/D_{ES}(c^2 - a^2) \cdot [c/a \cdot \exp(-ax) - \exp(-cx)]$$

$$(ES)_0 = D_Sc^2S_0/D_{ES}a(a + c)\,;\quad a^2 = k_3/D_{ES} \quad (5)$$

Referring to Fig. 1, we see that for all values of x there will be a flux of ES to the right. Likewise, there will be a continual return flux (from right to left) of the free enzyme E, although this is not evident under the assumption that E is constant.

In order that active transport occur, the passenger species, or those molecules that are transported against their gradient, must be bound more (or less) strongly to ES than they are to E. In the case where 1 mole of ES binds only 1 mole of a neutral passenger species R, we have:

$$D_R(d^2R/dx^2) + (KR/1 + KR) \cdot D_{ES}(d^2(ES)/dx^2) = 0 \quad (6)$$

where K is the equilibrium constant for the binding reaction. Solving Eq. 6 for the case of complete binding, $KR/(1 + KR) \cong 1$, we have

$$R - R_0 = D_{ES}/D_R \cdot [(ES)_0 - (ES)] \quad (7)$$

The maximal concentration achieved by the membrane would be

$$R_\infty - R_0 = D_{ES}/D_R \cdot (ES)_0$$

One can imagine many ways in which the binding characteristics of the enzyme-substrate complex might be different from that of the free enzyme. For instance, a slight change in the pK$_a$ of titratable groups that are in the neutral pH region will cause a change in the gross charge of the enzyme. Since electroneutrality must prevail in the immediate neighborhood of the protein, this means that a different number of counter ions will accompany the enzyme-substrate complex than accompany the free enzyme. Such pK shifts have been observed (*5*).

The interpretation of active transport along these lines is attractive for the following reasons. (i) It is in terms of enzyme reactions that are better understood and are encountered elsewhere in biological systems. (ii) It avoids postulating extreme differences in oxidation-reduction potentials, differences in voltage, differences in catalytic surfaces, and so forth.

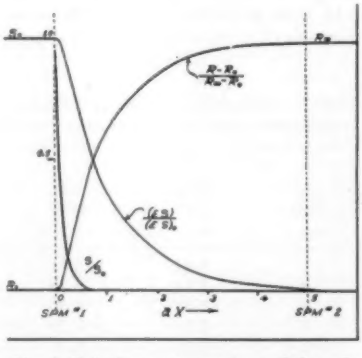

Fig. 1. Relative concentrations of the substrate S, the enzyme-substrate complex ES, and the transported passenger species R between two semipermeable membranes, $SPM\#1$ and $SPM\#2$. These have been calculated from equations 4, 5, and 7, respectively, assuming $c/a = 10$.

(iii) The coupling of the metabolic energy supply is explicit (the conversion of S to P). (iv) The specificity of ion transport can be interpreted in terms of the specific binding properties of the enzyme and/or enzyme-substrate complex.

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8 August 1955

Rodenticidal Effect on Pine Mice of Endrin Used as a Ground Spray

For many years, poison baits have been the basis for control of mice in orchards. World War II stimulated research involving bioassays on toxicity of hundreds of potential bait type rodenticides (*1*). In orchard practice, zinc phosphide, with all its limitations, is still rated above the newer materials. However, the lack of effectiveness of zinc phosphide led Kalmbach (*2*) to anticipate its replacement by other more suitable rodenticides.

Experience has shown that the sublethal acceptance of poisonous bait by numerous mice, coupled with the high reproductive capacity of these animals, places the dependability of poisoned baits for orchard mouse control in great doubt. One large Virginia orchardist loses about 600 to 700 apple trees annually, even though he uses poisoned baits close to maximum advantage. Since numerous reasons exist for such failures (*3*), the need for more effective mouse control is evident.

Since 1949, a number of potential ground spray rodenticides have been tested in orchards of Virginia, including endrin, the coined name for an insecticide. Endrin has been 100-percent effective in each of the past 3 years as a pine mouse control.

In the experiments in apple orchards reported here, the chemicals were applied as a ground spray to heavily mouse-infested plots that contained 42 trees each. All replicated plots were six rows wide and seven tree spaces long, or about 1.2 acres per plot. Since the range of pine mouse colonies is reported to be about ¼ acre (*4*), test plots nearly 5 times the maximum colony area were selected. The six center trees in each such treated plot appeared to be well protected from mouse invasion by the sprayed strips of orchard 70 or more feet wide and occupied by two surrounding "guard rows" of trees. A uniform ground spray was applied to a continuous straight strip 11 feet wide on each side of each row of trees. Preferably the treated strip reached to the trunk. For large trees, only 11 feet inward from the limb ends could be covered. Because pine mouse activity was concentrated in the tree rows (*3*), alleys between rows were not sprayed. The spray coverage was usually about 65 percent of the total orchard floor.

Table 1 indicates that there was a rapid decline in mouse activity to near final levels in 6 days or less during 1954. For 1953, a period of 3 to 6 weeks was required for a similar action. Apparently the difference in response is associated with moisture differentials in soil and cover. In 1953, the spraying was done under extremely dry conditions, which continued for some time. In 1954, at the time of spraying and subsequently, the orchard floor litter was moist, and the surface soil moisture was near field capacity.

As is the case with numerous other recent organic pesticides except DDT, the effect of endrin ground sprays on human beings and wildlife has not been well evaluated. The evidence that exists indicates that the orchard use of endrin as described here causes little or no evident deleterious effect on men or game animals. In the fall of 1954, one orchardist with extensive fruit plantings sprayed with a gun about 1000 acres of apple orchard. Members of the spray crews felt no ill effects. Neither was there any apparent reduction in numbers of quail or deer. None of the pets that had free range of the orchard died. A dog that closely followed one workman during the spraying was not visibly injured. In another 6-acre orchard area that was treated with endrin, active rabbits were observed during the period when mouse activity declined to zero. No increased vulture activity following endrin application was observed.

Table 1. Decline in pine mouse activity following endrin ground sprays in apple orchards. Mouse activity before the spraying was considered to be 100 percent.

Chemical	Endrin per 42-tree plot (lb)	Post-treatment mouse activity (%)		
		After 3–7 days	After 21–25 days	After 43–51 days
Plots sprayed 26–29 Nov. 1954				
Controls		67	83	58
(3 plots)		55	73	73
		90	91	91
Emulsifiable	2.50	0	9	0
endrin	2.50	0	10	0
(3 plots)	2.50	0	0	0
Emulsifiable	3.25	0	8	0
endrin	3.25	0	0	0
(3 plots)	3.25	8	8	0
Wettable				
endrin	2.50	0	0	0
(2 plots)	2.50	27	0	0
Plots sprayed 13–18 Nov. 1953				
Emulsifiable	1.5		30	40
endrin	1.5		0	30
(4 plots)	1.5		33	42
	1.5		8	33
Emulsifiable	2.5		25	0
endrin	2.5		0	0
(4 plots)	2.5		25	0
	2.5		33	0

An indication of the relative safety in the use of endrin is its acceptance for the control of insects on food plants. A label has been issued by the U.S. Department of Agriculture for the use of endrin on cabbage plants. This material was accepted earlier for tobacco insect control. As presently used against rodents, endrin is not applied either to the tree or to its fruits. Moreover, the treatments have been fully effective only in the dormant season when surface contamination of fruits could not occur.

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8 August 1955

Citation Indexes for Science

Eugene Garfield's article, "Citation indexes for science" [*Science* **122**, 108 (1955)], is interesting beyond doubt. If we had in our library a citation index such as he proposes, I should use it to advantage.

Amid today's overwhelming difficulties in scientific communication, however, this index would solve too few problems to justify its surely great cost at this time.

Even though all the cited references in a given article were indexed, those ideas and key words not covered by the cited references would remain excluded, according to Garfield's system. The most

valuable parts of a research paper, the author's own contributions, would thus fare no better than they do today.

In our present indexing journals, many key words are not indexed at all; a paper's title—and even its summary—often can display only a few of the author's ideas. Excellent thoughts, particularly concerning technique, may lie buried deep within an article, lost to the index-reading "public." It is precisely the inventive, busy author who will neglect to publish a significant idea in the form of a separate paper. A citation index, much as it may be worthwhile, would fail to catch and broadcast such an idea.

My suggestion in regard to literature indexing would be to continue and greatly expand the sort of skilled, discriminating indexing that is found in the Armed Forces Medical Library's *Current List of Medical Literature* and in *Chemical Abstracts*, publications that are excellent despite their limited budgets.

The status of the Armed Forces Medical Library should be changed to that of an independent Federal Medical Information Bureau. *Chemical Abstracts* and similar publications should be supported *in part* by the government. Congress should appropriate a truly adequate sum of money to provide these organizations with highly trained indexing personnel (minimal education: M.S. degree).

An impractical dream? All right; but this sort of action, which would conform to the Hoover Commission's recommendation for greater support of basic medical research (*Philadelphia Inquirer*, 1 July 1955) is just what is needed to begin the attack on our massive problem of scientific communication.

Other subsequent efforts in this direction would include the formation of an International Scientific Journal Union (to supervise prompt publication) and the development of departmentalized scientific newspapers as reported by J. A. Behnke [*Science* **120**, 1055 (1954)].

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4 August 1955

If the cost of preparing a citation index were comparable to the cost of conventional indexes, this cost would be justified by virtue of the time and money it could save in research. Fortunately, the cost of citation indexes per entry is extremely low because the bulk of the work can be performed by clerks and machines. *Shepard's Citations* adds more than 1 million citations to its cumulations each year. Even though Shepard's Citations, Inc., has a large staff of qualified attorneys, their published volumes are not exorbitantly priced. As Schoenbach surely knows, the subscription rates for such indexes as the *Bibliography of Agriculture* and the *Current List of Medical Literature* do not reflect their true publication costs. And the government does, in fact, do what Schoenbach wishes it did—support such activities *in part*. If any additional support is forthcoming, it should be from industry and other nongovernmental index users.

Schoenbach implies that a citation index for science is meant as a substitute for the conventional subject indexes rather than an adjunct. This is by no means true. The lawyer may use a digest —that is, a conventional index—as his starting point. Having located an array of references pertinent to his search, he then goes to *Shepard's Citations* for all subsequent citations to the cases in point.

Schoenbach also implies that the *Current List* and *Chemical Abstracts* do keyword indexing—that is, indexing based on titles. This is also incorrect. Each of these publications indexes articles in great depth. However, the number of indexing entries applied has an economic as well as an *intellectual limit*. In a paper I recently presented before the American Chemical Society, "Breaking the subject-index barrier—A citation index for chemical patents," I discussed this all-important "barrier"—the inability of the indexer, no matter how conscientious, to catch the total import of an author's remarks. Furthermore, the author himself is not always aware of the implications of his own discoveries. It is precisely because, as Schoenbach states, "Excellent thoughts, particularly concerning technique, may lie buried deep within an article, lost to the index-reading 'public' " that a citation index is needed. When the use and construction of the citation index is properly understood, then it will become apparent that it can help to "broadcast" these otherwise buried ideas.

When Schoenbach criticizes the limitations of the proposed citation index, he really criticizes present citation practices. There are numerous instances when an author could provide a citation that would establish the necessary association between his new contribution and what has gone before. If it is completely new and unrelated to anything previously published, then the idea will in most cases be caught by the indexer. If neither the author nor the indexer is aware of its significance, some other author will bring it out through a subsequent citation. Through the citation index, one could then use the antecedent article as a new starting point.

I would wholeheartedly support any move to expand the services of the *Current List* through increased financial support from the government or any other interested parties. Hopefully, its expanded services could include a citation index. Since the conventional subject index and the citation index complement each other in a synergistic fashion, this would, I think, be a great stride forward for science. However, this important problem is in no way related to the merits of the citation index and should receive a more thorough treatment in the pages of *Science* and elsewhere.

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28 October 1955

Bactericidal Reaction of Mouse Serum

The lack of bactericidal effect of mouse serum on some gram-negative organisms *in vitro* has been reported (*1*). The mouse is unique in this respect since the normal serums of other mammals exert a marked bactericidal effect on gram-negative organisms. This bactericidal effect of normal serums results from the concerted action of normal antibody and C′ (*2*).

Because of the widespread use of the mouse in immunological investigations, it was significant to determine whether the lack of bactericidal action of normal mouse serum results from a lack of normal antibody or bactericidal C′ or both. Most studies of the action of C′ have used a standard hemolytic system of rabbit antiserum against sheep erythrocytes. Mouse C′ is practically lacking in hemolytic activity in the standard system, although some reaction may be elicited under particularly sensitive conditions (*3*). Guinea pig C′ is extremely active in this system. Bovine serum is without activity, but it is among the most potent sources of C′ in the bactericidal system against *Brucella* organisms (*4*) and *Salmonella typhosa* (*5*). The failure of mouse serum to exert a bactericidal effect could not be attributed arbitrarily, therefore, to a low level of hemolytic C′ since no simple association exists between hemolytic and bactericidal C′.

The turbidimetric growth assay technique was used for determining bactericidal reactivity with *S. typhosa* 0901 (*5*). The assay technique consists of two phases: (i) a reaction period of 60 minutes during which the organisms are exposed to the inhibitory action of antibody and C′ in the presence of an optimum concentration of Mg ion (*5*) that is incorporated in the saline diluent; (ii) the relative numbers of surviving organisms are then estimated by subculture and optical density determinations in a photoelectric colorimeter. Assays of hemolytic C′ were performed with the standard hemolytic system (*6*), C′ was fractionated by the dialysis method, C′3 was in-

activated by zymosan (*7*), and C'4 by ammonium hydroxide (*8*).

Several pools of fresh mouse serums were tested alone, and in amounts up to 0.5 ml failed to show detectable bactericidal action. Fresh mouse serum was combined with heat-inactivated (56°C for 30 minutes) normal and immune human and rabbit serums, but no bactericidal effect was observed. These results indicate a deficiency of bactericidal C' in mouse serum. The lack of hemolytic C' in mouse serum is thus paralleled by a lack of bactericidal C'.

To determine the particular C' component that is lacking in mouse serum, M (*9*) and E (*10*) and C' lacking C'3 and C'4 were prepared from human and guinea pig serum pools. Fresh mouse serum was added to these fractions, and the reinforced serum was tested for its hemolytic and bactericidal activity in the presence of excess antiserum. Mouse serum proved capable of activating guinea pig E and guinea pig C' lacking C'4 to a marked extent in the hemolytic reaction (Table 1). Mouse serum thus appears to be able to furnish components C'1 and C'4. Its inability to activate guinea pig M and guinea pig C' lacking C'3 to any appreciable extent suggests a deficiency of C'2 and C'3. Mouse serum did not activate similar human serum complement fractions. In the bactericidal reaction, mouse serum was able also to activate guinea pig E and guinea pig C' lacking C'4 (Table 2). The combined guinea pig fractions did not function as an effective C', probably because of loss of activity resulting from the fractionation procedure and the relatively large volumes of C' that are required for the bactericidal reaction. Human C' fractions were not tested.

These results suggest a relative deficiency of C'2 and C'3 in mouse serum in both the hemolytic and bactericidal reactions. Hemolytic experiments alone have shown previously that mouse serum is lacking in C'2 (*11*). Our findings are in agreement, but they also indicate a relative lack of C'3.

The next experiments were performed to determine whether mouse serum possessed normal bactericidal antibody despite its lack of bactericidal C'. C' was prepared by absorbing guinea pig serum with heat-killed organisms to remove normal antibody. The combined effect of this absorbed C' and mouse serum was determined. Definite bactericidal action resulted. The logarithm of the amounts of mouse serum plotted against the probit of the percentage of killed organisms yielded a straight line. This relationship has been observed in titering other normal serums and antiserums. Two pools of unheated mouse serums each required about 0.3 ml to kill 50 percent of a test dose of about 2×10^7 organisms. A three to four-fold loss of activity occurred as a result of heat inactivation (56°C for 30 minutes) of the mouse serum. Such thermal instability is characteristic of normal antibody.

The lack of bactericidal action of mouse serum may be attributed, therefore, to a lack of complementary activity notwithstanding the presence of normal antibody. The complement deficiencies are in C'2 and C'3 components. However, C'1 and C'4 appear to be present and effective in supplementing guinea pig fractions that lack these components in both the hemolytic and bactericidal reactions. Normal bactericidal antibody, as found in other animals, is present in the mouse.

The C' deficiency of mouse serum raises doubts concerning the validity of protection tests in mice for gaging the immunizing action of vaccines of gram-negative organisms. Nevertheless, protection tests giving a positive result are qualitatively valid. The role of serum bactericidal components in immunity to infection with gram-negative organisms is not clear. Whatever part it does play would seem to be inadequately assessed in the mouse.

Table 2. Bactericidal action of mouse serum and guinea pig C' components with excess of inactivated rabbit antiserum against *S. typhosa* 0901. Saline diluent was added to bring all tubes to equal volume. Controls with each fraction, separately, and lacking mouse serum were negative.

Tube	Rabbit antiserum, 1/400 (ml)	Guinea pig				Mouse serum (ml)	Culture (ml)	Kill (%)
		M (ml)	E (ml)	Serum lacking C'3 (ml)	Serum lacking C'4 (ml)			
1	0.1	0.1	0.1	0	0	0	0.3	0
2	0.1	0	0	0.1	0.1	0	0.3	0
3	0.1	0	0.1	0	0.1	0	0.3	0
4	0.1	0.1	0	0.1	0	0	0.3	0
5	0.1	0.1	0	0	0	0.2	0.3	0
6	0.1	0	0.1	0	0	0.2	0.3	75
7	0.1	0	0	0.1	0	0.2	0.3	0
8	0.1	0	0	0	0.1	0.2	0.3	75
9	0.1	0	0	0	0	0.2	0.3	0
10	0.1	0	0	0	0	0	0.3	0
11	0	0	0	0	0	0	0.3	0

Table 1. Hemolytic action of mouse serum and guinea pig C' components on sheep erythrocytes optimally sensitized with rabbit antisheep hemolysin. Saline diluent was added to bring all tubes to equal volume. Controls with each fraction, separately, and lacking mouse serum were negative.

Tube	Guinea pig				Mouse serum (ml)	Sensitized rbc (1½%) (ml)	Hemolysis (%)
	M (ml)	E (ml)	Serum lacking C'3 (ml)	Serum lacking C'4 (ml)			
1	0.1	0.1	0	0	0	1.0	80
2	0	0	0.1	0.1	0	1.0	100
3	0	0.1	0	0.1	0	1.0	100
4	0.1	0	0.1	0	0	1.0	90
5	0.1	0	0	0	0.5	1.0	0
6	0	0.1	0	0	0.5	1.0	50
7	0	0	0.1	0	0.5	1.0	15
8	0	0	0	0.1	0.5	1.0	70
9	0	0	0	0	0.5	1.0	0
10	0	0	0	0	0	1.0	0

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12 August 1955

Detection of Staphylococcus Enterotoxin by Infrared Spectrophotometry

This communication describes briefly the results of an infrared spectrophotometric examination of boiled and lyophilized preparations that were obtained from cultures of enterotoxigenic and nonenterotoxigenic staphylococci (*Micrococcus pyogenes* var. *aureus*) in accordance with the "cold-ethanol" method developed by Thatcher and Matheson (*1*). The products were known to contain variable amounts of α-, β- and δ-hemolysins and differed widely in enterotoxigenic activity.

Exploratory experiments were carried out on specimens mounted between two silver chloride disks in a specially constructed demountable microcell. A drop of the aqueous concentrate was placed on one of the disks, a stream of dry nitrogen was passed over it to remove excess solvent, and the specimen was thoroughly dried over phosphorus pentoxide. Then its absorption was measured in a Perkin-Elmer double-beam recording infrared spectrophotometer. Remarkable contour similarity was noted to exist among the various spectral curves that were obtained by this procedure, and it soon became apparent that only a quantitative evaluation of the absorption characteristics of the different preparations might prove to be of diagnostic value.

Accordingly, the specimens were finely powdered in a mechanical grinder until they would pass through a 250-mesh sieve (U.S. Standard Sieve Series No. 230). An accurately weighed portion of 5 mg was then mixed intimately with 995 mg of ACS reagent grade potassium bromide that had been prepared similarly and dried overnight at 125°C. A 200-mg aliquot of the mixture was subjected in a vacuum for about 5 minutes to a pressure of 10,000 lb/in.^{2} The absorbancy of the clear disk thus produced was measured over the frequency range extending from 4000 to 650 cm^{-1}. A potassium bromide disk prepared under comparable conditions was placed in the path of the reference beam to compensate for absorption by the reagent. After each experiment, the disks were weighed accurately in order to determine the amount of specimen per sample. The variations between different disks never exceeded 1 percent.

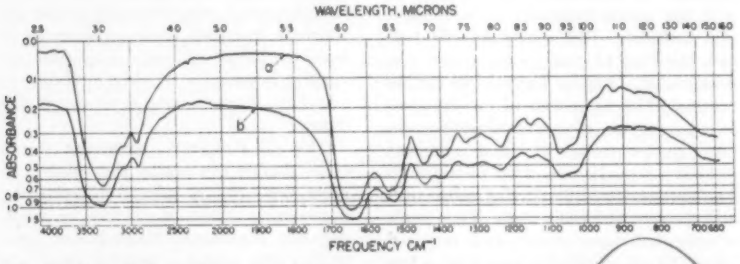

Fig. 1. Infrared absorption curves of 12069α Dolman preparation measured by the silver chloride technique (*a*), and the potassium bromide technique (*b*).

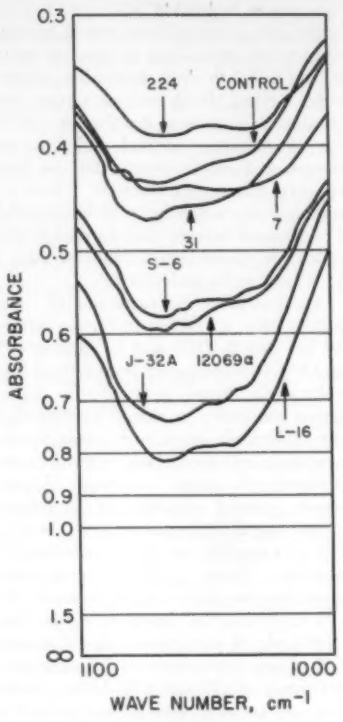

Fig. 2. Infrared absorption of seven strains of *M. pyogenes* var. *aureus* throughout the 1100–1000 cm^{-1} region.

Table 1. Correlation between enterotoxicity and infrared absorption of a specific fraction* of the filtrates of seven strains of *M. pyogenes* var. aureus.

Strain	Enterotoxicity (cat test)			Area under curve from 1100 to 1000 cm^{-1} (cm^2)
	Material injected† (mg)	Cats injected (No.)	Cats vomiting in 2 hr (No.)	
L16	2	4	4	15.8
J-32A	2	4	3	18.5
S6	2	4	3	23.7
	5	1	1	
12069α	2	4	4	23.8
Control media	2–5	4	0	32.4
31	2–5	4	0	30.4
7	2	4	0	30.7
224‡	2	4	0	33.8
	5	1	0	

* Water-soluble precipitate obtained by the "cold-ethanol" procedure of Thatcher, Matheson, and Simon (*1*).
† All material dissolved in 2 ml of 0.95-percent saline prior to injection.
‡ This strain is usually weakly enterotoxic but was found to contain no enterotoxin in this particular preparation.

Figure 1 shows two spectral curves obtained on one of the preparations (12069α Dolman) using both the silver chloride and potassium bromide techniques. Strong N—H and characteristic C—H stretching vibrations are observed at 3400 cm^{-1} and 2900 cm^{-1}, respectively. The marked absorptions noted at 1650 and 1540 cm^{-1} are indicative of the presence of polypeptide bonds, while the characteristic band occurring at 1065 cm^{-1} may be considered to be associated with ester linkages such as —C—O or C—O—P that are found in phospholipids.

Because all samples were treated identically by the pressed potassium bromide technique, their absorbancies could be compared by accurately measuring cor-

responding areas subtended by the various spectral curves throughout specific wavelength intervals. The 1100 to 1000 cm^{-1} region proved to be the most informative one (see Fig. 2), for the intensity of the absorption band observed at 1065 cm^{-1} was always found to be higher for preparations showing enterotoxigenic activity than it was for preparations that were biologically inactive. In the latter, the magnitude of the 1065 cm^{-1} absorption approached always closely that shown by the control media (Table 1).

Boiling of culture filtrates is known to cause the destruction of practically all hemolysins present (*2*) and is accompanied by the formation of a dense precipitate. The latter was removed from the specimens by filtration. Enterotoxin is not destroyed by the boiling process, however, and it represents the only biologically detectable active principle in the specimens examined.

Spectral differences due to the presence or absence of specific lysins remain to be adequately explored. The method reported appears, however, to allow for the detection of enterotoxin in appropriately treated preparations. It is planned to offer further details for publication elsewhere.

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27 June 1955

Reabsorption of Cobalt-60 from Urine and Bile Samples of Experimental Dogs

Investigators have reported on the metabolic fate of cobalt (*1*). They generally agree that cobalt is excreted mainly in the urine after intravenous injection and that a smaller fraction may be recovered from the bile. When cobalt is administered orally, a large fraction is excreted in the feces and considerable amounts are found in the urine. Our own work has confirmed these observations in chickens (*2*) and dogs (*3*). It is the aim of these studies to report the intestinal absorbability of the cobalt that is excreted in the urine and bile (*4*).

The hepatic bile and urine samples from an experimental dog (*3*) were employed. Pooled samples were collected between 0 and 4, 4 and 8, and 8 and 12 hours after the initial intravenous injection of 10 μc of Co^{60} per kilogram (*5*). These were then diluted with physiological saline and were injected directly into the lumen of the gizzard of groups of 3-day old White Leghorn chicks as indicated in Table 1. Each group consisted of 11 birds. All chicks were killed ½ hour later. The intestinal tracts from above the proventriculus down to the cloaca were removed and ashed in a muffle furnace at 500 to 600°C for 5 hours. They were then weighed and counted under a thin mica end-window Geiger-Müller tube. Standards were prepared by adding known quantities of Co^{60} solution to the intestinal tract that had been removed from noninjected chicks and ashed and counted in the same manner. Since the weights of all the ashed samples were about the same (group means, 9.6 to 10.5 mg/cm^2), no self-absorption correction was applied.

Table 1. Cobalt-60 recovery (percentage of injected dose) from intestinal tract of young chicks and absorption half-times when it was injected as urine or bile.

Injection	Amt. Co^{60} injected	Intestinal Co^{60} recovery	Half-time disappearance from intestine
	(μc)*	(%)†	(min)†
$Co^{60}SO_4$	0.406	70.8 ± 4.3	62.5 ± 13.3
0 to 4 hr Urine	0.303	38.6 ± 2.3	21.9 ± 1.4
4 to 8	0.298	37.1 ± 4.6	21.2 ± 2.5
8 to 12	0.223	40.9 ± 4.3	23.5 ± 2.6
Mean		38.9 ± 4.1	22.2 ± 4.2
0 to 4 hr Bile	0.175	41.1 ± 3.6	23.5 ± 2.2
4 to 8	0.266	45.1 ± 3.5	26.3 ± 2.4
8 to 12	0.309	45.5 ± 2.9	26.6 ± 2.2
Mean		43.9 ± 3.9	25.5 ± 4.8

* The specific activity was 0.5 μc/μg. † Mean ± standard error.

The data are presented in Table 1. When inorganic Co^{60} was injected, the intestinal recovery of Co^{60} was significantly greater than that of Co^{60} injected as urine or as bile. It will be noted, accordingly, that the half-time of disappearance of Co^{60} from the intestine was longer in the group that received inorganic Co^{60} than it was in those that received urine or bile samples. It has been found that the turnover rate of Co^{60} in dogs is faster for its amino acid complex forms than for its inorganic form (*6*). It might be possible that inorganic Co^{60} administered to a dog is complexed before it is excreted in the urine or the bile.

Paper partition chromatography of the urine and bile samples, using autoradiograms to locate the spots containing Co^{60}, was also studied. Although inorganic Co^{60} apparently accounted for a large majority of the radioactivity, additional radioactive components were present in both the urine and bile samples. However, in no specific case was it possible to conclude that more than a very minute trace of the Co^{60} in either urine or bile samples was in the form of vitamin B_{12} (*7*). The existence of some forms of Co^{60} other than its inorganic form in the intestinal wall and its contents of the chicken (*2*), in the blood plasma of the dog (*8*), and in the tissues of the sheep (*9*) has been discussed.

In summary, a form (or forms) of Co^{60} other than its inorganic form was found in the bile and in the urine samples that were collected from experimental dogs. The Co^{60} in these samples is reabsorbed from the gut of young chicks at a considerably faster rate than inorganic Co^{60} is absorbed.

CHENG-CHUN LEE*
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References and Notes

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18 August 1955

Book Reviews

Mesons and Fields. vol. II, *Mesons.* Hans A. Bethe and Frederic de Hoffmann. Row, Peterson, Evanston, Ill. 1955. xiii + 446 pp. Illus. $8.

Mesons is the second volume of a two-volume set on the general subject of high-energy physics. Volume I, which has not yet been published, is devoted primarily to modern quantum field theory, whereas volume II is concerned largely with meson physics, and in fact, mostly with π-meson physics.

These books are the outgrowth of a series of lectures given by Bethe at Cornell University to an audience containing a good fraction of experimental physicists. As a result, a great deal of space is devoted to the analysis of experimental data in terms of fundamental theoretical parameters. This is an aspect of physics that is frequently shunned by "pure" theoreticians and its appearance will warm the hearts of experimentalists.

The first two chapters of the book describe the experiments that have uncovered the fundamental character of π-mesons—for example, spin, parity, mass, and so forth. Following an introductory survey of the experimental data, the subject of pion-nucleon scattering is taken up in earnest. The ideas of charge independence and the formalism of isotopic spin as applied to this problem are presented with great clarity. The analysis of scattering data in terms of phase shifts is treated in great detail, and all experimental data are closely scrutinized. The next major topic is the photoproduction of pions, where again the experimental data are gleaned from all information and translated into a form suitable for comparison with theory.

After a brief historical review of meson theory, the general theory of the Tamm-Dancoff method is developed in great detail and applied to a calculation of pion scattering on the basis of pseudoscalar meson theory. Various theories of photomeson production are described and compared with experiment.

A short discussion is given of several theoretical attempts at calculating nuclear force from meson theory. The theory of meson production is treated primarily phenomenologically. The book ends with a summary of the most important experimental facts and theoretical conjectures about μ-mesons and curious particles.

There is one feature of the book that may cause difficulty for beginners and that is the fact that very many theoretical calculations are described for a given process even when some of the treatments are quite contradictory. The authors have not chosen to be arbitrators. The dilemma that faced them was not of their own making: it has proved singularly difficult to extract reliable information from meson theory and a decision in favor of any given calculation is at the present time often hard to reach. Despite this difficulty, *Mesons* fills an important need and will be of great value to students and research workers.

MARVIN L. GOLDBERGER
University of Chicago

Astronomical Cuneiform Texts. vol. I, *Introduction: The Moon.* vol. II, *The Planets.* vol. III, *Plates.* O. Neugebauer, Ed. Lund Humphries, London, 1955. vol. I: xvi + 278 pp. Illus. vol. II: xii + 233 pp. Illus. vol. III: 255 pp. Plates. £5 5s. per set.

Conventional accounts of the development of the physical sciences are likely to begin with the creation of science in ancient Greece (the "miracle" of Greek science) and then skip to Galileo and his age (when "modern science" was "invented"). Research in the history of the exact sciences has been filling in two major gaps, the interval between the decline of ancient science and the age of Galileo, and the long ages before the Greek philosophers supposedly invented science. In recent decades, the heroic labors of O. Neugebauer and his associates have unveiled the pre-Greek history of mathematics and astronomy. We now know that many Greek discoveries, such as the Pythagorean theorem and the theorem of Thales that an angle inscribed in a semicircle is a right angle, were known long, long before to the Babylonians. Neugebauer, conscious of the scholarly tradition of which he is the greatest luminary, dedicates the present work to three Jesuit fathers who pioneered the study of Babylonian astronomy, J. N. Strassmaier, J. Epping, and F. X. Kugler.

The present work is based on some 300 clay tablets and fragments that were excavated in Mesopotamia and are now to be found in museums in Istanbul, Paris, London, Berlin, and America. These tablets contain ephemerides for the sun, moon, and planets, or computational procedures. Each table is transcribed in the now standard adaptation of Hindu-Arabic numerals to the sexagesimal notation of the Babylonians; for the scholar there are photographs and drawings of tablets. These astronomical tablets date from the Seleucid period, roughly coeval with Greek mathematical astronomy, and are much later than the mathematical tablets.

Although it was not Neugebauer's intention to write a history or descriptive account of Babylonian astronomy, the "general introduction" to each section and the discussions of each of the texts enable the reader to follow the main outlines of the subject. The primary object of the Babylonian theory of the planets proves to have been the determination of the time and longitude of consecutive "characteristic phenomena," such as the first and last visibilities and stationary points in the east and west for the inferior planets and the first visibility in the east, first stationary point, opposition, second stationary point, and last visibility in the west for the superior planets. This is quite different from the aims of Ptolemy's astronomy, in which the goal was to find the geocentric latitude (and longitude if needed) of any planet at any given time.

Neugebauer points out that this difference has a bearing on astrology in that the "characteristic phenomena" in the Babylonian ephemerides "play no role whatsoever in astrological practice." The position of the planets in the zodiacal sign at date of birth, which is of primary interest to the astrologer, can be found by the Ptolemaic methods, but this type of problem "is *not* immediately solvable from the ordinary Babylonian ephemerides." Neugebauer says: "The Babylonian approach is obviously the 'natural' one. What one realizes first about the planets is their appearance and disappearance in the nightly sky, their stations and retrogradations. To predict these phenomena seems to be the real problem and it was solved by our texts by means of very ingenious arithmetical devices. But it marks an enormous step forward to ignore the 'natural' problems altogether and to ask an apparently much more complex question: how to describe the planetary motion as a whole. It is this shift of emphasis which led Apollonius, Hipparchus, and Ptolemy to their enormous successes."

The ephemerides of the moon show the Babylonian concern for calendarial problems. The beginning of each month occurred at the first visibility of the new moon's crescent. Hence the aim of Babylonian lunar theory was to predict accurately the evening on which this event would occur, which might be at the end of either a 29- or 30-day interval. Cognate problems are the determination of the syzygies, last visibilities of the moon, and eclipses. "The results," Neugebauer concludes, "are amazingly good and can hardly be improved upon with elementary mathematical means. It is not surprising that the theory of eclipses is the weakest part of the whole theory because one essential element, the parallax of sun and moon, is completely disregarded."

Neugebauer tells us that this edition of *Astronomical Cuneiform Texts* is "intended to furnish the basis for a chapter on Babylonian Mathematical Astronomy in a larger History of Ancient Astronomy." In that work, Neugebauer will undoubtedly deal with the major questions of the extent to which these mathematical methods may have influenced the later course of astronomy, on which topic he has given us an earnest in his *Exact Sciences in Antiquity*. For the present, we must be content with his careful presentation of the methods and calculations at almost the beginnings of exact physical science.

I. Bernard Cohen
Harvard University

The Chemistry and Fertility of Sea Waters. H. W. Harvey. Cambridge Univ. Press, London, 1955. viii + 224 pp. $5.50.

The vigorous and imaginative writings of earth scientists are in part responsible for the popularity enjoyed by their fields of interest. H. W. Harvey, one of the pioneering scientists of marine chemistry, has written a vigorous book on the chemical interactions of the plants and animals of the sea with their environment. His ability to focus attention on the significant variables influencing population changes in the ocean and the importance of his own extensive experimental work have given his previous writings a prominent and influential place in oceanography.

His present book is divided into two parts. The first concerns changes in the composition of marine waters as a result of biological activity, while the second part describes the chemical composition of the hydrosphere. A final chapter, in collaboration with F. A. J. Armstrong, considers some of the more popular chemical analyses made in productivity studies. The noncritical air that pervades this book is somewhat compensated by the full documentation and bibliography. The neglect of the extensive postwar Japanese work is disappointing.

The book will find and deserve its principal audience among entrants to the fields of marine biology and chemistry. The chapter on the carbon dioxide system of the oceans and marine water compositional changes owing to the flora and fauna stand out as elegant presentations. The recent successes of isotopic and atomic chemistry in interpreting natural phenomena, such as Thode's sulfur work and Urey's carbonate thermometry, are not cited. Such omissions are a neglect of potentially powerful tools that are available for application to the yet unsolved problems of marine productivity.

Edward D. Goldberg
Scripps Institution of Oceanography

Diffusion and Heat Exchange in Chemical Kinetics. D. A. Frank-Kamenetskii. Trans. by N. Thon. Princeton Univ. Press, Princeton, N.J., 1955. xii + 370 pp. Illus. $6.

As its title indicates, this interesting and important treatise deals with the theories of processes that involve chemical reactions as well as heat and material flow. The subject might be said to be intermediate between fluid dynamics and isothermal chemical kinetics in static systems, but it actually involves both of these. Scientific interest in the subject is a natural consequence of the rapid advances in classical chemical kinetics, but the subject has also acquired a major practical importance because of current industrial interest in rapid-flow reactors and in combustion phenomena. In the West, the subject has been approached more frequently from the point of view of fluid dynamics; in the U.S.S.R., it has been mainly explored by N. N. Semenoff and his pupils, who were trained as chemical kineticists. Among Semenoff's pupils, the author of this book is known for his many important theoretical contributions, which have placed him in a small group of internationally known experts in the field.

The book starts with a brief chapter summarizing the basic concepts of the theory of chemical kinetics and the theory of diffusion and heat transfer, including the effects of laminar and turbulent flow. Chapter II, "Diffusional kinetics," deals with reactions at surfaces the rates of which may be controlled either by kinetic or diffusional factors. The third chapter considers the condensation of vapors. The fourth is a brief exposition of the theory of thermal diffusion. Chapter V, "Chemical hydrodynamics," is devoted largely to the nature of the boundary layer in streaming fluids. The sixth, seventh, and eighth chapters are devoted to the theories of thermal explosions and of the propagation of flames. Chapter IX, "Thermal regime of heterogeneous exothermal reactions," deals mainly with the problem of ignition at solid surfaces. The last chapter contains brief comments on the theory of periodic chemical processes.

Even this brief listing of the main subdivisions of the book should give some idea of the importance of the problems dealt with. Throughout the text the author makes frequent use of dimensional analysis (similitude theory) and is thus able to obtain approximate solutions to problems that appear insoluble by analytic techniques.

To an experimentalist, the book will be a rich source of ideas for experimental work; a theoretician will find many problems requiring further analysis.

The translation of this difficult text is the work of the late N. Thon. "Editing was restricted to verifying technical consistency in translation and consistency with usage of expression in the field," states the editor. Unfortunately, very little evidence of this editing is apparent. Regarded as a first draft, the text is an outstanding accomplishment; as a final version, it is, to say the least, much below par. It abounds with technical inconsistencies ranging from an almost (but not completely) consistent reference to the Reynolds, Prandtl, and other such numbers as "criteria" to devoting pages 51 and 52 of the book to a discussion in which the term *mass velocity* is used when the subject matter is clearly momentum. The heat of reaction is indiscriminately referred to as "heat effect" or "thermal effect." Typographic errors are very numerous. Some polishing of the style would have made the book much more readable. The price seems excessive.

G. B. Kistiakowsky
Harvard University

Grundlagen der Analytischen Chemie und der Chemie in Wässrigen Systemen. Fritz Steel. Verlag Chemie GmbH, Weinheim/Bergstrasse, 1955. 348 pp. Illus. DM. 29.

As the author indicates in his foreword, this is not a textbook of analytical chemistry. It is, rather, a physicochemical treatment of the principles of chemical equilibrium as applied to aqueous solutions and a fundamental exposition of the theoretical principles of qualitative and quantitative analysis. As such, it may be expected to serve both as a supplement to sets of laboratory directions in beginning analytical chemistry

and as a helpful reference and guide for such a course of instruction. Because of its orderly and logical presentation, its completeness, and its clarity, the book will be welcomed by both student and teacher. It should serve each admirably and it should be a useful reference work in the technical laboratory as well.

The treatment throughout is modern and quantitative. The discussions are interestingly and clearly presented, and the mathematical approaches are logical and easy to follow. Numerous tabular and graphical presentations of data add to the scope of the volume and increase the general appeal that the volume has. Many of these represent new and stimulating points of view and are of particular utility in demonstrating the importance of theory as applied to laboratory practice. After an introduction to general principles and solution chemistry, the discussion proceeds to the law of mass action. These concepts are then extended to precipitation, complex-ion, acid-base, water, indicator, ion-exchange, and oxidation-reduction equilibria, and additional chapters deal with reactions in fused salts, buffer solutions, quantitative methods involving various types of equilibria, and electrolytic precipitation and separation processes. The appendix gives a comprehensive tabulation of equilibrium constants of various types and standard oxidation potential data.

In my opinion, this is an exceptionally well written book and one which anyone interested in the theoretical basis for analytical chemistry would be advised to examine. The publishers are to be complimented also upon the excellence of the printing and binding and upon the over-all attractiveness of the volume.

THERALD MOELLER
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Books Reviewed in The Scientific Monthly

January

The Crime of Galileo, G. de Santillana (Univ. of Chicago Press). Reviewed by R. J. Seeger.

Management of Addictions, E. Podolsky, Ed. (Philosophical Library). Reviewed by K. M. Bowman.

Practical Horticulture, J. S. Shoemaker and B. J. E. Teskey (Wiley; Chapman & Hall). Reviewed by G. V. S. Raynor.

Patent Law in the Research Laboratory, J. K. Wise (Reinhold). Reviewed by H. G. Dyke.

Island Bibliographies, M. H. Sachet and F. R. Fosberg (National Acad. of Sciences–National Research Council). Reviewed by E. H. Walker.

Hungry Generations, H. Boner (King's Crown Press). Reviewed by F. J. Weiss.

Laboratory Studies in Biology: Observations and Their Implications, C. Lawson, R. Lewis, M. A. Burmester, G. Hardin (Freeman).

Introducing Sea Shells, R. T. Abbott (Van Nostrand). Reviewed by J. W. Hedgpeth.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Les Corrections Barométriques dans la Nouvelle Convention Internationale. Contributions, No. 20. R. Sneyers. 11 pp. *Aperçu des Circonstances Météorologiques et Climatologiques de la Tempête des 31 Janvier et 1 Fevrier 1953.* No. 21. Lucien Poncelet. 43 pp. *Eléments de Météorologie.* No. 22. Chapitre I, *Considerations Générales*; P. Defrise, 23 pp. Chapitre II, *Instruments et Observations*; P. Defrise, J. Grandjean, L. Poncelet; 48 pp. *Projet d'une Expedition Scientifique sur le Continent Antarctique.* No. 23. Edmond Hoge. 6 pp. *Techniques Modernes de Mesure de l'Éclairement Énergétique Solaire.* Publ. Serie B., No. 16. R. Dogniaux et R. Pastiels. 49 pp. *Contribution à l'Étude Théorique de la Variation Locale de la Pression Atmosphérique.* No. 17. A. Vandenplas. 17 pp. Institut Royal Météorologique de Belgique, Bruxelles, 1955.

Archaeological Reconnaissance in Central Guatemala. Publ. 608. A. Ledyard Smith. Carnegie Institution of Washington, Washington, 1955. 87 pp. Paper, $3.85; cloth, $4.35.

Commonwealth Fund, Annual Report, 1955. Thirty-seventh annual report for the year ending 30 June 1955. Commonwealth Fund, New York, 1955. 46 pp.

University College of Khartoum, Sudan, First Annual Report of the Hydrobiological Research Unit. July 1953 to June 1954. 23 pp. *Second Annual Report of the Hydrobiological Research Unit.* July 1954 to June 1955. 24 pp. The University, Khartoum, Sudan, 1955.

Atomic Age—The Tenth Year. Developments since the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 8 August 1955. International Review Service, New York, 1955. 21 pp.

New Himalayan Species of Pedicularis with Special Reference to Those from the Eastern Himalaya. Bull. Brit. Mus. (Nat. Hist.) Botany, vol. 2, No. 1. P. C. Tsoong. The Museum, London, 1955. 34 pp. 8s.

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Segundo Catálogo General de Colecciónes Micológicas Latino Americanas. Centro de Cooperación Científica para América Latina de la UNESCO, Montevideo, Uruguay, 1955. 111 pp.

Metallurgy. Vocational and Professional Monogr. Ser., No. 33. Alvin S. Cohan. Bellman, Cambridge 38, Mass., 1955. 20 pp. $1.

Amputees and Prostheses: Report of a Conference on Prosthetics. Copenhagen 23–28 August 1954. WHO Tech. Rept. Ser., No. 100. World Health Organization, Geneva, 1955. 52 pp. $0.60.

California Institute of Technology, Annual Report, 1954–1955. Bull., vol. 64, No. 4, The Institute, Pasadena, Calif., 1955. 143 pp.

The Buhl Foundation, A Report by the Director upon Its Work to June 30, 1955. The Foundation, Pittsburgh, Pa., 1955. 145 pp.

Scientific Personnel Resources. A summary of data on supply, utilization, and training of scientists and engineers. 86 pp. $0.50. *Education and Employment Specialization in 1952 of June 1951 College Graduates.* 78 pp. $0.35. National Science Foundation, Washington 25, 1955 (Order from: Supt. of Documents, GPO, Washington 25).

New Medicines for the Mind—Their Meaning and Promise. Pamphlet No. 228. Gilbert Cant. Public Affairs Committee, New York, 1955. 26 pp. $0.25.

John and Mary R. Markle Foundation, 1954–1955 Annual Report. The Foundation, New York, 1955. 72 pp.

Handbook of Toxicology. vol. I. WADC Tech. Rept. 55-16. William S. Spector, Ed. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, 1955. 408 pp.

Distribution and Ecology of the Marine Invertebrates of Point Barrow, Alaska. Smithsonian Misc. Collections, vol. 128, No. 9. G. E. MacGinitie. Smithsonian Institution, Washington, 1955. 201 pp.

New Zealand Society of Soil Science, Proceedings of the First Conference. Held as section M of the 8th New Zealand Science Congress, Auckland, 17–21 May 1954. 32 pp. $0.60. *The Role of Soil Science in New Zealand Problems.* First presidential address, New Zealand Society of Soil Science. N. H. Taylor. 12 pp., $0.15. New Zealand Soc. of Soil Science, Wellington, 1955.

The Species of Middle American Birds. A list of all species recorded from Mexico to Panama, with suggested English names, outlines of range, and a distributional bibliography. Transactions, vol. VII. Eugene Eisenmann. Linnaean Soc. of New York, New York 24, 1955. 128 pp.

Midwest Inter-Library Corporation and the Midwest Inter-Library Center, Sixth Annual Report. 1 July 1954 to 30 June 1955. Midwest Inter-Library Center, Chicago 37, 1955. 23 pp.

New York State Mental Health Commission, Fifth Annual Report. For the fiscal year ended 31 March 1954. Dept. of Mental Hygiene, New York State, Albany, 1955. 26 pp.

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Biology of Poliomyelitis. Annals of the New York Acad. of Sciences, vol. 61, art. 4. 328 pp. *Nutrition in Infections.* vol. 63, art. 2. 174 pp. *Psychotherapy and Counseling.* vol. 63, art. 3. 114 pp. Ray Waldo Miner, Ed. New York Acad. of Sciences, New York, 1955.

Experimental Programs in Brazil. Bull. No. 6. J. C. Medcalf, W. L. Lott, P. B. Tetter, and L. R. Quinn. IBEC Research Inst., 30 Rockefeller Plaza, New York 20, 1955. 59 pp.

Scientific Meetings

Iroquois Research

The usefulness of the informal research conference for exploring some central theme, for identifying new research problems, and for reporting research accomplished was again achieved 14–16 Oct. 1955 when students of the Iroquois Indians of New York and Ontario met for the ninth time in 10 years at Red House, N. Y., to discuss the theme, "Exploring ways of achieving cooperation in anthropological studies in the Northeast." This theme provided a vehicle for discussing state and local relationships in archeology, professional and amateur responsibilities in archeology and ethnology, the roles of local and regional museums, and relationships between universities as training centers and the opportunities provided by the conference for field work.

The conference was limited to 35 invited participants who had recently contributed to the advancement of Iroquoian research, of whom 28 attended. The Red House conferences are traditionally family affairs; until the rains of this year, the glorious autumn weather has made these week-ends a pleasant outing. For the continued use of the administration building and quarters of the Allegany State Park, the conference is indebted to Charles E. Congdon, chairman of the Allegany State Park Commission, and to M. H. Deardorff of Warren, Pennsylvania, who was host at the "doings" of the Very Little Water Society.

The annual Iroquois Conference owes its inspiration to the late F. G. Speck and has from the beginning been organized and chaired by W. N. Fenton, who this year was assisted in planning by W. A. Ritchie and C. E. Gillette. The conference has no formal organization and no regular members. The attendance comprises mainly anthropologists, many of whom are part-time workers in archeology, ethnology, language, and history—the only prerequisite is an active and contributing interest in some phase of Iroquoian studies.

The agenda included the following discussions: State and Local Relations led by John Witthoft (Pennsylvania Museum Commission); Professional and Amateur Relations led by William A. Ritchie (New York State Museum and Science Service); Museum and University Relations, Irving Rouse (Yale University); Ethnologist and Indian, Anthony F. C. Wallace (University of Pennsylvania); and the Structure of Support, W. N. Fenton. The discussions lasted throughout Saturday and were actively engaged in by everyone present. Those who did not have a chance to say all that occurred to them in the meeting carried on in small groups far into the night. On Sunday morning, we heard from the "new voices" in Iroquoian research, who were introduced by Wallace. These included Jacob Gruber (Temple University) on a study of artistic styles in Iroquois masks; Cara B. Richards (Cornell University) on a study of women's roles at Onondaga; David Landy (Harvard University) on child-rearing practices of the Tuscarora; and Anne-Marie Shimony (Yale University) on the longhouse communities of Six Nations Reserve, Ontario.

The chairman summarized the high points of the conference as follows:

1) The need had been identified for an archeological extension service from the New York State Museum and Science Service to local societies, schools, and collectors of New York antiquities.

2) The present type of conference on the theme of improving state and local relationships in antiquities of New York should be repeated at the local level; such additional conferences are contemplated.

3) Sentiment favored education and diffusion of professional scientific knowledge to the use of legal sanctions to prevent vandalism of sites; it was held that an antiquities act would be unworkable.

4) Universities such as Yale and Toronto should encourage research by state and local museums but must evaluate these programs in the light of national responsibilities. It is recognized that Iroquoian studies in archeology, ethnology, and linguistics have provided part-time research opportunities for the faculties and field training for graduate students.

5) It was evident that in arriving at an over-all program for the conference, one must know the number of students available in the universities of the area and what parts of the program each university would assume. There is a need to identify a few solid projects in language, social relations and political organization, personality studies, archeology, and linguistics to show how the main concept of conservatism can be studied in relation to change, using the Iroquois field as a laboratory.

6) From the "new voices" came the suggestion of a clearing house of research in progress and research in the recent past so that young scholars might approach the field in an intelligent manner.

The discussions and recommendations on Saturday and Sunday followed the presentation of a paper appropriate to the theme for the conference that was delivered this year by Thomas Grassmann of the Mohawk-Caughnawaga Museum at Fonda, N.Y., on "The excavation of historic Caughnawaga." Grassmann's talk was illustrated by slides; it highlighted, very appropriately, excellent cooperation between professional and amateur scholars in a local setting.

Of the conference last fall, two things can be said: it identified a new field of research in the area of Indian education that is in the trend of the times, when education and anthropology are finding common research interests. In the selection of the theme and in the candor with which it was discussed, the conference touched one of the significant problem areas in the organization of scholarship—namely, how to foster good communications among national, state, and local levels of the community of science without control flowing from the top, and how provide the amateur, part-time scholar with a sense of full participation.

W. N. FENTON

New York State Museum and Science Service, Albany

Meeting Notes

■ Roger M. Blough, chairman of the board, U.S. Steel Corporation, will be the principal speaker at the opening session of the winter general meeting of the American Institute of Electrical Engineers at the Hotel Statler, New York, 30 Jan.–3 Feb. It is estimated that more than 5000 engineers, scientists, and industrialists will attend the 98 sessions, at which some 500 papers on electrical engineering and the allied arts will be presented.

■ The first International Symposium on Venereal Diseases and the Treponematoses will be held at the Statler Hotel, Washington, D.C., 28 May–1 June. The symposium will be sponsored by the Public Health Service, U.S. Department of Health, Education, and Welfare, and the World Health Organization. Clarence A.

Smith, chief of the Public Health Service's Venereal Disease Program, is in charge of arrangements for the symposium, which is expected to draw more than 500 specialists in the field of venereal disease and the treponematoses. Invitations are being sent to individuals in many foreign countries with the cooperation of WHO, the International Union Against Venereal Disease, and the Pan American Sanitary Bureau.

The symposium is open to all physicians, scientists, and professional health workers. Anyone interested in submitting a paper should send an abstract *before 1 Feb.* to Dr. C. A. Smith, Venereal Disease Program, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D.C.

The working languages of the symposium will be French, Spanish, and English. Arrangements are being made for simultaneous interpretation of papers in all three languages during the course of the meeting.

■ The American Astronomical Society will meet at Ohio State University 21–24 Mar. Both the radiotelescope at Ohio State and the 69-inch optical telescope at Perkins Observatory will be available to meeting participants. A panel discussion on "Radiotelescopes, present and future" will be a feature of the program. For information write to the secretary of the society, Dr. J. Allen Hynek, McMillin Observatory, Ohio State University, Columbus 10.

■ The fall meeting of the Society for the Scientific Study of Religion, which took place at Harvard University, featured addresses on religion from the point of view of a psychiatrist, H. A. Murray; an anthropologist, Clyde Kluckhohn; a sociologist, Talcott Parsons; and a natural scientist, Phillip Frank.

The spring meeting, which is to be held in New York on 21 Apr., will have as its theme "The ministry as a profession." There will be room on the program for a few unsolicited papers preferably, though not necessarily, relating to this topic. Three copies of an abstract of not more than 300 words should be sent *before 15 Mar.* to the chairman of the planning committee, Charles Y. Glock, Bureau of Applied Social Research, Columbia University, New York 27, N.Y.

Society Elections

■ Kresge-Hooker Science Library Associates: pres., Harvey Merker, Parke-Davis and Company, Detroit, Mich.; v. pres., Thomas Boyd; sec.-treas., Icie Macy Hoobler, Merrill-Palmer School, Detroit; acting exec. sec., Wendell H. Powers, Wayne University. Representative to the AAAS Council is Byron Soule.

■ American College of Dentists: pres., Kenneth C. Pruden, Paterson, N.J.; pres.-elect, Gerald D. Timmons, Temple University; v. pres., Hunter S. Allen, Birmingham, Ala.; treas., William N. Hodgkin, Warrenton, Va.; exec. sec., O. W. Brandhorst, 4221 Lindell Blvd., St. Louis, Mo. Representative to the AAAS Council is George C. Paffenbarger.

■ Soil Conservation Society of America: pres., E. H. Graham, U.S. Soil Conservation Service, Washington, D.C.; 1st v. pres., J. S. Russell, Des Moines Register and Tribune, Des Moines, Ia.; 2nd v. pres., R. G. Hill, Michigan State University; treas., Howard F. Barrows, Austin-Western Co., Aurora, Ill.; exec. sec., H. Wayne Pritchard, 1016 Paramount Bldg., Des Moines, Ia.

■ Society for Experimental Stress Analysis: pres., S. S. Manson, National Advisory Committee for Aeronautics; sec.-treas., W. M. Murray, Massachusetts Institute of Technology. The vice presidents are M. M. Leven, Westinghouse Electric Corporation, and E. Wenk, Jr., David Taylor Model Basin. Representative to the AAAS Council is Miklos Hetenyi.

■ Optical Society of America: pres., Ralph A. Sawyer, University of Michigan; exec. v. pres., I. C. Gardner, National Bureau of Standards; v. pres. for meetings and local sections, Stanley S. Ballard, Scripps Institution of Oceanography, University of California; sec., Arthur C. Hardy, Massachusetts Institute of Technology; treas., E. D. McAlister, Eastman Kodak Company.

■ New Mexico Academy of Science: pres., John Harty, New Mexico Institute of Mining and Technology; v. pres., Edward G. Damon, Alamogordo High School; sec.-treas. and representative to the AAAS Council, C. Clayton Hoff, University of New Mexico.

Forthcoming Events

February

7–9. Western Joint Computer Conf., annual, San Francisco, Calif. (D. C. Holmes, Shell Development, Emeryville, Calif.)

9–10. Soc. of American Military Engineers, annual, Chicago, Ill. (D. A. Sullivan, 72 W. Adams St., Chicago 90.)

9–11. Inst. of Radio Engineers, 8th annual Southwestern regional conf., Oklahoma City, Okla. (C. O. Hart, Box 764, Oklahoma City.)

13–17. American Soc. of Civil Engineers, Dallas, Tex. (ASCE, 33 W. 39 St., New York 18.)

16–17. National Conf. on Transistor Circuits, 3rd, Philadelphia, Pa. (J. D. Chapline, Remington Rand, Inc., 2300 W. Allegheny Ave., Philadelphia 29.)

19–23. American Inst. of Mining and

Metallurgical Engineers, New York, N.Y. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

19–23. Soc. of Economic Geologists, New York, N.Y. (O. N. Rove, Union Carbide and Carbon Corp., New York 17.)

20–22. American Educational Research Assoc., annual, Atlantic City, N.J. (F. W. Hubbard, AERA, 1201 16 St., NW, Washington 6.)

23–25. National Soc. of College Teachers of Education, Chicago, Ill. (C. A. Eggertsen, School of Education, Univ. of Michigan, Ann Arbor.)

24–25. American Physical Soc. Houston, Tex. (K. K. Darrow, APS, Columbia Univ., New York 27.)

26–29. American Inst. of Chemical Engineers, Los Angeles, Calif. (F. J. Van Antwerpen, AIChE, 25 W. 45 St., New York 36.)

28–29. Scintillation Counter Symposium, 5th, Washington, D.C. (G. A. Morton, RCA Laboratories, Princeton, N.J.)

March

9–10. Midwest Conf. on Theoretical Physics, Iowa City, Iowa. (J. M. Jauch, Dept. of Physics, State Univ. of Iowa, Iowa City.)

12–16. National Assoc. of Corrosion Engineers, 12th annual, New York, N. Y. (Secretary, NACE, Southern Standard Bldg., Houston 2, Tex.)

14–17. National Science Teachers Assoc., Washington, D.C. (R. H. Carleton, NSTA, 1201 16 St., NW, Washington 6.)

15–16. Food Physics Symposium, 1st international, San Antonio, Tex. (C. W. Smith, Southwest Research Inst., San Antonio.)

15–17. American Orthopsychiatric Assoc., 33rd annual, New York, N.Y. (M. F. Langer, AOA, 1790 Broadway, New York 19.)

15–17. American Physical Soc., Pittsburgh, Pa. (K. K. Darrow, APS, Columbia Univ., New York 27.)

15–17. Kappa Delta Pi, annual, Stillwater, Okla. (E. I. F. Williams, 238 E. Perry St., Tiffin, Ohio.)

16–18. International Assoc. for Dental Research, St. Louis, Mo. (D. Y. Burrill, 129 E. Broadway, Louisville 2, Ky.)

17–18. National Soc. of Professional Engineers, annual spring, Washington, D.C. (K. E. Trombley, NSPE, 1121 15 St., NW, Washington 5.)

18–24. American Soc. of Photogrammetry, annual, joint meeting with American Cong. on Surveying and Mapping, Washington, D.C. (ACSM–ASP, Box 470, Washington 4.)

19–21. Div. of Fluid Dynamics, American Physical Soc., Pasadena, Calif. (F. N. Frenkiel, Applied Physics Lab., Johns Hopkins Univ., 8621 Georgia Ave., Silver Spring, Md.)

19–22. American Acad. of General Practice Scientific Assembly, 8th annual, Washington, D.C. (AAGP, Broadway at 34th, Kansas City 11, Mo.)

19–22. Inst. of Radio Engineers National Convention, New York. (E. K. Gammett, IRE, 1 E. 79 St., New York 21.)

19–23. American Soc. of Tool Engineers, Chicago, Ill. (H. C. Miller, Armour Research Foundation, 35 W. 33 St., Chicago 16.)

21–22. National Health Forum, New York, N.Y. (T. G. Klumpp, National Health Council, 1790 Broadway, New York 19.)

21–23. American Power Conf., 18th annual, Chicago, Ill. (R. A. Budenholzer, Illinois Inst. of Technology, Chicago 16.)

21–24. American Astronomical Soc. Columbus, Ohio. (J. A. Hynek, McMillin Observatory, Ohio State Univ., Columbus.)

23–24. Eastern Psychological Assoc., Atlantic City, N.J. (G. G. Lane, Univ. of Delaware, Newark.)

24–25. American Psychosomatic Soc., 13th annual, Boston, Mass. (T. Lidz, APS, 551 Madison Ave., New York 22.)

24–31. Perspectives in Marine Biology, La Jolla, Calif. (A. A. Buzzati-Traverso, Scripps Institution of Oceanography, La Jolla.)

25–28. American Assoc. of Dental Schools, annual, St. Louis, Mo. (M. W. McCrea, 42 S. Greene St., Baltimore 1, Md.)

25–29. American College Personnel Assoc., Washington, D.C. (Miss C. M. Northrup, Univ. of Denver, Denver, Colo.)

(See 16 Dec. issue for comprehensive list)

Equipment News

■ GAS AND STREAM ANALYZER for automatic processing of pharmaceuticals, plastics, rubber, chemicals, petroleum, food, paper, and cosmetics is manufactured by Axler Associates. The instrument is designed to be used in conjunction with narrow-band infrared, ultraviolet, and visible transmission filters for studying gaseous or chemical constituents by the methods of emission, transmission, or absorption spectroscopy. (Axler Associates, Inc., Dept. Sci., 102–42 43rd Ave., Corona 68, N.Y.)

■ REFRIGERATED ANGLE CENTRIFUGE has a maximum capacity of 2000 ml, a maximum speed of 15,500 rev/min, and direct motor-to-rotor drive. Seven different Servall rotors may be spun in the unit; maximum speed for large heads is 3500 rev/min; maximum speed for the medium heads is 5000 rev/min. Both the large and medium heads can be held at temperatures below 0°C. (Ivan Sorvall, Inc., Dept. Sci., Norwalk, Conn.)

■ LIQUID LEVELER operates with open containers that hold conductive liquids, automatically maintaining the liquid level within ± 0.046 in. of that desired. The portable unit includes electronic relay, stainless steel probes, solenoid valve, nickel-plated copper tubing, and brass needle valve. Current of 3 μa produces positive action. (Blue M Electric Co., Dept. Sci., 138th and Chatham St., Blue Island, Ill.)

■ HYDROGEN ANALYZER for determination of the hydrogen content of titanium, zirconium, and similar metals and alloys utilizes ¼-g samples in any solid form. The apparatus, which has a range from 5 to 700 parts per million, works on the principle of hot extraction of hydrogen in a vacuum. The standard analyzer uses a recording Pirani gage to measure and record on a strip chart the hydrogen evolved from a sample. (National Research Corp., Equipment Div., Dept. Sci., 160 Charlemont St., Newton Highlands 61, Mass.)

■ VAPOR PHASE CHROMATOGRAPHIC APPARATUS provides a simple and rapid analytic method for gases and liquids used for primary analysis where its accuracy, which ranges from 1 to 4 percent of component, is adequate. Chromacon apparatus is designed to be used as a supplement to distillation methods; it resolves fractions that are not separable by distillation alone and provides a method for the analysis of low-boiling hydrocarbon mixtures. (Podbielniak, Inc., Dept. Sci., 341 E. Ohio St., Chicago 11, Ill.)

■ POTASSIUM THISIYANATE labeled with carbon-14 has been made available in various package sizes under regular Atomic Energy Commission licensing procedures. (Nuclear Instrument and Chemical Corp., Dept. Sci., 229 W. Erie St., Chicago 10, Ill.)

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Pharmacologist. Vacancy in our laboratories for Research Associate, M.S. degree, with some experience in neurophysiology and electroencephalography. In confidence, send complete résumé and salary requirements. Schering Corp., Manufacturer of Fine Pharmaceuticals, 60 Orange St., Bloomfield, N. J. X

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(a) Assistant Director, division of clinical investigation, pharmaceutical company; duties: evaluation new therapeutic agents, working with clinical investigators in university and research centers, developing new drugs; physician required. **(b) Medical Editor;** M.D. or Ph.D.; outstanding opportunity, important organization, leading its field. **(c) Assistant Director,** excellently equipped laboratories for scientific criminal investigation; Ph.D., trained in physiology, pharmacology, human anatomy, pathology. **(d) Statistician** to serve as assistant or associate professor, university school of medicine. S1-1 Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

Zoologist with Ph.D. completed or in process, to teach first course in either vertebrate embryology, comparative anatomy, or field biology, and to assist in general biology. Send complete résumé, including salary desired to Thorton W. Merriam, Dean, Springfield College, Springfield 9, Massachusetts. X

Translators. Must have specialized knowledge one or more sciences in following languages: from Russian into English, from French and Spanish into English and from English into French and Spanish. Full or part-time work, contract basis. Submit detailed, typed résumé and sample translation. Consultants Bureau, 259 W. 14 St., New York 11, N.Y. X

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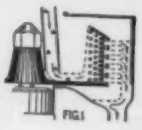
FIG.1


FIG.2

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11 inch	3000 ml.	3500	1900 x G.

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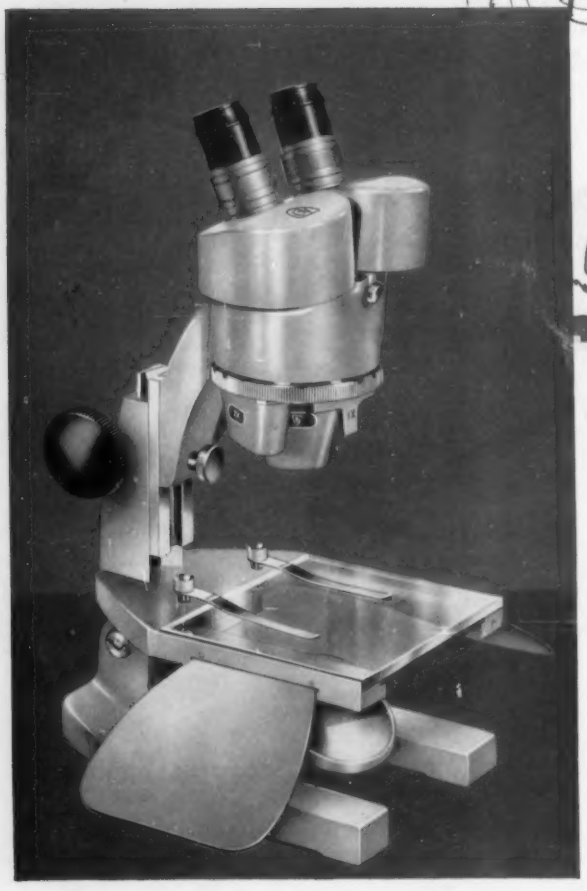

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